WORLD SWORDFISH FISHERIES

Volume IV

Latin America

Part B. Caribbean

Section 4. Montserrat to Puerto Rico

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An Analysis of Swordfish Fisheries, Market Trends, and Trade Patterns
Past-Present-Future

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Latin America

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Prepared by
The Office of Science and Technology

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SECTION 4

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PERSONAL OBSERVATIONS

"Plymouth was the major port and city on Montserrat. Much of the island's small fisheries catch was landed and sold here. The town with its important fishing jetty has been destroyed by eruptions of the Soufriere Hills Volcano. My photographs show the now devastated city with the volcano and gas plume in the background." -- Matthew Watson, Michigan Tech, April 19, 2001

"The Netherlands Antilles is implementing a compliance requirement for its vessels in order to support and comply with international and legal instruments and conditions. The registry of the Netherlands Antilles has a 50 year history of ships flagged and is a well-known register in the marine world. The existence of a local and international fishing fleet creates a serious challenge to the Department of Shipping and Maritime Affairs, especially considering the management of policy development to a fleet with high standards." -- Bernhard Komproe, Director of the Department of Shipping and Maritime Affairs, November 13, 2000

"Our company operates Spanish purse seiners which target yellowfin tuna which we sell in the European market. The vessels are deployed in the eastern Atlantic off West Africa. The vessels, however are registered here in the Netherlands Antilles." -- Elisa Inkel, Overseas Tuna Company, August 5, 1999

"Unfortunately we now have some Spanish purse seiners operating under our flag, some of them of the famous 'Albacora' company. These vessels do not come here, they don't even enter the Caribbean. They do not employ locals and pay only about $500 annually in fees. Nevertheless they exert considerable influence with some parties. It is a serious pest." -- Gerard VanBuurt, Curaçao Fisheries Section, April 3, 2001

"The most common fishing methods used are trolling, line fishing, seine fishing, and trap fishing. There is wide awareness among those who use the reef of a rapid decline in abundance and catches of valued reef organisms, and studies indicate that densities of large piscivores (groupers, snappers, jacks, barracuda) are low. The Agriculture and Fisheries Service of Curaçao considers the reef to be overfished and is alarmed by the continued overcapitalization of the fishery sector." -- Adolphe O. Debrot (CARMABI) and Jeffrey Sybesma (UNA)

Curaçao officials believe that longliners, perhaps deploying a combination of gear, are needed to diversify the fishing industry by developing the pelagic fisheries north of Curaçao and Bonaire. "To prevent longlining would mean to turn the EFZ into a tuna and swordfish reservation that would only help maintain the catch of foreign distant-water fishermen." Officials go on to state, "Without longlining, developing a local fishery in the EFZ would be impossible." -- Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," July 2001.

"We are a young company here on Curaçao and have only been operating seriously for 2 months with a Louisiana-built steel longliner. Our main targets are tuna and sword, but we have a bycatch of oilfish, mahi, and mako. We have made 5 export shipments and even more earlier. -- Arie Zuurmond, Blue Caribbean Seafood, March 23, 2001

"Large Taiwanese longliners enter the harbor in St. Maarten to tranship. However, they do not sell any of that fish in the local market. All the fish is sold out of the country, however, you can find some species of fish (swordfish and mahi-mahi) in local supermarkets. The supermarket fish is all imported product." -- Andy Caballero, Nature Foundation

"We are one of the few Caribbean recreational operations that offer the opportunity to take a swordfish. Our operation is based on Aruba and we have conducted night trips for swords. We catch them at depths of in 40-60 meters at drop-offs of 1,000 meters or more. They are tremendous fighters. I estimate that they are 60 percent more of a fighter than the 493 kilogram blue marlin we caught." -- Alfredo Pichardo, Teaser Charters

"The biggest news for the U.S. tuna canning industry is H.J. Heinz (owners of StarKist) announcement of closing the StarKist tuna canning plant in Puerto Rico's west coast city of Mayagüez. The 40 year old plant was once Puerto Rico's largest employer with 4,000 workers. .... StarKist like other tuna processors has been struggling with the weak tuna prices." -- CASAMAR, February 2001

"Our small-scale fishermen here on Puerto Rico are very upset about the new Federal regulations which require licenses for highly-migratory species and prohibit the landing of billfish. The fishermen especially object because while they can not land billfish, the species can be taken and landed by recreational fishermen. They do not think this is fair." -- Ruperto Chaparro, Sea Grant, May 14, 1999

"Recreational fishermen are ... involved in the catch of billfish during [Puerto Rican] tournaments that range between the months of June to December. This activity requires prolonged and geographically scattered enforcement efforts due to the quantity and location of the fishing clubs. It is my opinion that these tournaments are one of the main contributors to the heavy exploitation of the species. During a tournament held during the week of October 5, 2001 at the Club Deportivo de Mayagüez, a recreational fisherman advised this agent that billfish over 300 pounds are rarely caught these days. He made reference to the catch dating back to 10-15 years when a 300 pounder was frequent." -- Santos R. Gonzalez, NMFS Special Agent, October 9, 2001

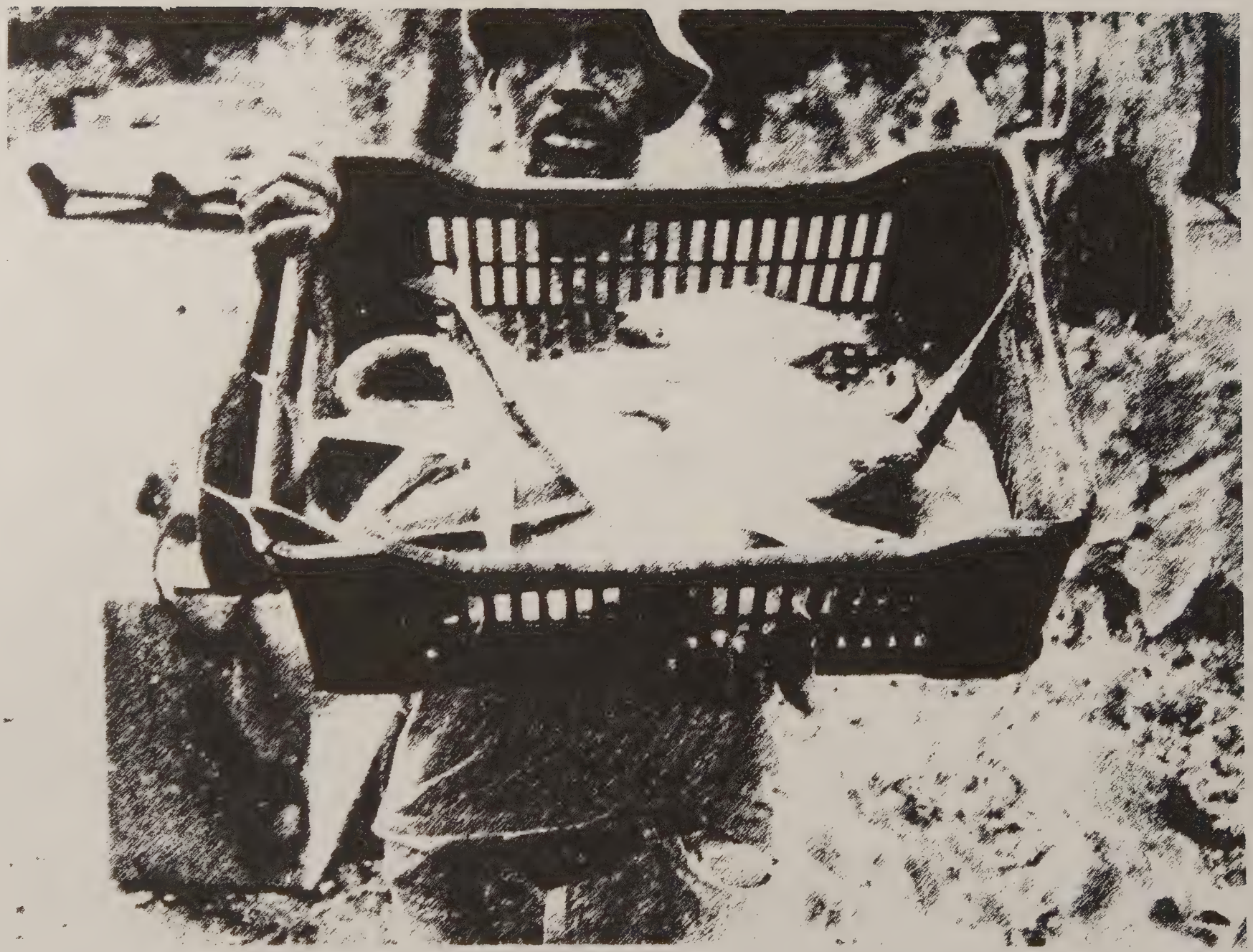
"We are the most successful Fisherman's Association on Puerto Rico. Many of the other ones have failed because the fishermen are difficult to organize. Our fishermen in particular target tuna and we help market the catch. Some of our fishermen are now involved with recreational chartering." -- Félix Morales, Vice President of the Villa de Ojo Association de Pescadores, June 24, 1999

"I've been handling swordfish off these distant-water longline boats for about 20 years. .... Our primary target is to handle the distant-water boats here in the United States, the local fleet. We buy fish from about 20 boats that fish the Grand Banks and Georges Bank here in the summer and the fall. These boats then go down to the Caribbean and we buy a lot of fish out of Florida and the Gulf and out of the Caribbean area and fly those fish back to Boston and New York. -- David Horton, McClean's Seafood

"Here in Puerto Rico our fishermen do no operate longliners or target swordfish. There are U.S. mainland longliners which operate out of San Juan on a seasonal basis. They market a small part of their catch locally. Our local fishery is heavily over fished, both by our small-scale as well as the recreational fishermen. We have drafted regulations to control this overfishing which we hope to finalize in 2001. " Craig Lilyestrom, Chief of the Marine Resources Department, May 9, 2001

"We assist the U.S. mainland longliners which operate out of San Juan. We market some of the catch here in Puerto Rico. Most of their catch including the swordfish and tuna is shipped to the mainland. Some swordfish and tuna as well as many bycatch species is marketed here in Puerto Rico. As the longliners only operate seasonally this means that this supply is not available year round." -- José Colón, Fresh Fish Company, June 14, 2001

"The once very extensive U.S. mainland operations out of San Juan has fallen sharply. Just a few years ago the fishermen were reporting over 100 trips annually. In 2000 there were only five longliners working out of San Juan and they made only 17 trips." -- Angelo Bertolino, NMFS, September 19, 2001



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MONTSERRAT

Montserrat had one of the smallest and most traditional fishing industry in the Caribbean. Foreign fishermen visiting the island suggest that coming to Montserrat is like going back in time. There has been no commercial fishing from Montserrat. Artisanal fishermen conduct largely inshore operations from small boats. Fishermen in recent years have reported some progress in initiating limited fisheries for offshore pelagics. The island's small fishing industry, however, has been decimated by calamitous volcano eruptions and hurricanes. One major limitation to the modernization of the fishing industry has been the lack of a port for commercial vessels. A new port was finally built in 1993 at Plymouth, the capital and largest city, only to be destroyed a few years later by an eruption of the Soufriere Hills Volcano that has devastated large portions of the island. The Volcano has forced the evacuation of Plymouth as well as the whole southern part of the island. This has sharply reduced the market available to the small number of fishermen who have continued to fish. Available reports suggest that a longliner was unsuccessfully deployed by a Montserrat fisherman in the early 1990s. Montserrat currently has no commercial longliners. The lack of a port and the small size of the EEZ suggest that it is unlikely that fishermen will acquire commercial longliners in the foreseeable future.

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Figure 1.--Map of the Leeward Islands

I. Overview

A. Background

Montserrat was discovered by Columbus in 1493. Columbus named the island after a noted monastery on Montserrat--a Spanish mountain. The island was claimed and colonized by Britain who brought Irish settlers to the island in 1632. It was temporarily occupied by French possession twice, 1664-68 and 1782-84. It has been a British crown colony since 1871. Montserrat was part of the Federation of the Leeward Islands from 1871 until 1956 when the Federation was dissolved. At that time Montserrat became a separate colony.

Montserrat is currently a British Crown colony. A new constitution was approved in 1990. The Government is appointed by the Crown and has responsibility for the territory's external affairs. The island's internal affairs are administered by the locally elected Government of Montserrat headed by the Chief Minister.[1]

The economic life of the island in recent years has been adversely affected by a series of natural disasters, both hurricanes and volcanos. The island was devastated in 1989 by Hurricane Hugo, causing damage of over $300 million--a huge sum on a small island like Montserrat.[2] The island since 1995 has been under siege from the Soufriere Hills Volcano. An eruption during August 1997 destroyed Montserrat's capital and main port, Plymouth. A pyroclastic flow, which is a horrific stream of heated rock, ash, and gases, set fire to many buildings in Plymouth. Further eruptions buried much of Plymouth beneath drifts of ash. An eruption in September 1997 destroyed the island's airport at Trant's. Flows of heated gas set fire to the complex. As a result, the southern half of the island has had to be evacuated. More than half Montserrat's population has evacuated the island. The Volcano appears to have quieted down in 1998, but it will take years for the island to recover.

Montserrat was virtually unknown to the world outside the Caribbean before the Volcano eruption in 1995. Unfortunately the island's new found fame has not assisted the island's fledgling tourist industry. The Volcano has attracted some intrepid tourists, especially the more ecologically oriented tourists interested in seeing a Volcano. Most Caribbean vacationers, however, are more interested in tranquil palm fringed beaches than a ranging volcano overlooking their hotel.

B. Fishing industry

The Montserrat fishing industry makes a very small contribution to the island's economy. Montserrat fishermen target demersal and pelagic resources on inshore grounds. OECS reported in 1994 that more than half of the catch is composed of coastal and other pelagic species.[3] Fishermen also take demersal finfish, about 30 percent of the catch is taken on the shelf and deep slop. Lobster and conch account for about 10 percent of the catch. About 220 fishermen were active in the 1980s, operating approximately 80 small boats.[4] A report from the early 1990s suggested 175 fishermen operating 80 boats.[5] About 70 percent of the fishermen are engaged in full-time fishing operations. The number of boats because of the Volcano is now substantially reduced. A CARICOM report estimates about 50 boats, but is undated.[6]

Fishery officials report in 1983 that fishermen used largely traditional methods, although the introduction of outboard motors significantly increased fishing effort. Fishing methods included seining (during the summer) and pots (all year round). The government in the early 1980s promoted the use of other gear, including trolling, longlining, and gillnets.[7] A visitor in 1986 reported that visiting Montserrat was like going back generations.[8] Fishermen launch their boats, many as small as 4-5 m by 4:00 am. The small outboards limits fishing to within about 1 km of the

Photo 1.--Typical day's catch for a Montserratian artisanal fisherman.

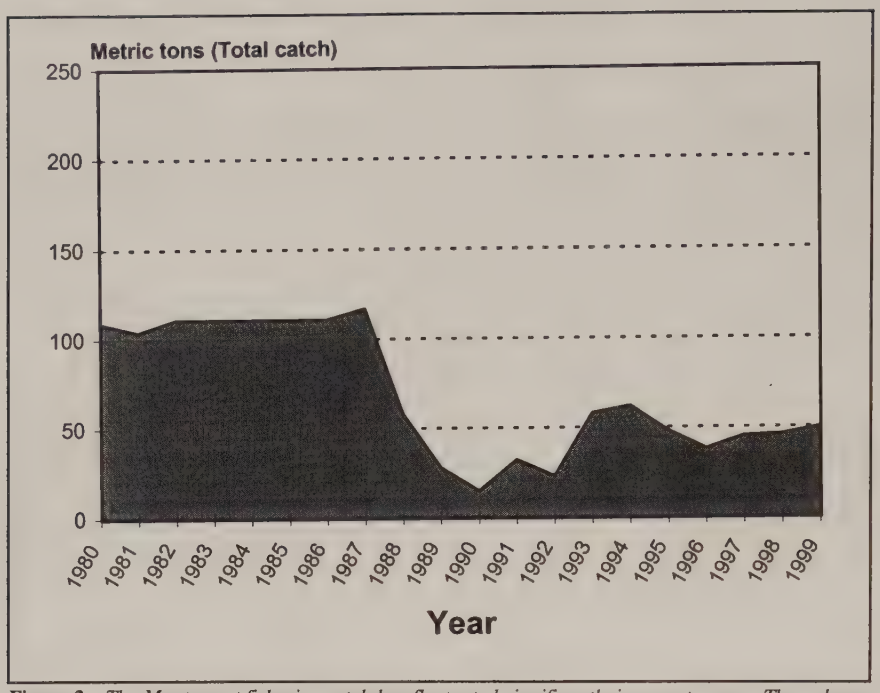

Figure 2.--The Montserrat fisheries catch has fluctuated significantly in recent years. The volcano eruptions since 1995 have devastated the industry.

coast. They take mostly ballyhoo, gar, grouper, marguarites, and silks. The tunas, king mackerels, jacks, corvally, and dorados available further offshore, as late as the mid-1980s, were beyond the reach of traditional fishermen in their small boats.[9] At least some local fishermen during the 1990s have adopted new methods and gear and have begun to target offshore pelagics.[10]

The Montserrat fisheries catch during the 1980s was about 110 t per year (appendix A). Catch data on Montserrat, however, are only rough estimates. Fishery officials in 1983 reported that they stopped collecting landings data in 1976.[11] Fishery officials reported that in the 1970s that inshore and adjacent waters had been heavily depleted by overfishing. Officials reported destructive practices such as dynamiting.[12]

The heavy fishing pressure on inshore stocks has been significantly reduced by a series of natural disasters. The catch was halved in 1988 because of Hurricane Hugo which destroyed or damaged large numbers of fishing boats. Many fishermen had managed to resume operations by the early 1990s and catches improved somewhat to 62 t in 1994 (appendix A). The eruption of the Soufriere Hills Volcano in 1995, however, again devastated the island. The major hurricanes (Luis and Marilyn) also caused considerable damage in 1995. Through these disasters, the already devastated fishing industry, was not as badly affected as might be imagined. Catches in 1996 declined to 38 t, but since 1997 have been little changed at 45-50 t (appendix A).

Even before the 1995 Soufriere Hills Volcano eruption, British consultants had concluded that there was little potential for expanding the country's small domestic fishing industry.[13] The limited domestic catch has not satisfied the domestic demand and Dominica in the early 1980s was importing about two-thirds of its seafood.[14] No fisheries trade data is

Photo 2.--The Soufriere Hills Volcano has devastated the port of Plymouth and its fisheries infrastructure as well as much of the southern part of the island. Matthew Watson

available through FAO (Caribbean Overview, appendices F1a-b). An earlier assessment indicated that there was relatively little interest on the island among young islanders in developing a modern fishing industry.[15]

II. Species

The authors know of no studies describing swordfish off Montserrat. Some limited data is available from foreign researchers or other sources from neighboring islands. Available information on swordfish in the northeastern Caribbean is discussed in the Anguillian and Antiguan chapter of this report as well as the other islands in the northeastern Caribbean.

III. Grounds

A. Oceanography

Montserrat is located north of the Caribbean Grenada Basin. Immediately south of the island is the Guadeloupe Passage connecting the Caribbean with the Atlantic Ocean. The island has been heavily hit by hurricanes in recent years. Especially severe storms were Hugo in 1989 and Luis and Marilyn in 1995.

B. Topography

Montserrat is a pear-shaped island which sits on its own small shelf. As with many of the northeastern Caribbean islands it shares a large expanse of sill area varying from 200-1,800 m in depth. With the exception of a narrow belt along the northern coast, there is virtually no under-water shelf area as the island is of volcanic formation; hence it slopes steeply down to deep-sea levels. The 100-fathom contour line in most areas is less than 2 km off shore. The island has an high-energy, erosion prone coast which makes handling boats difficult. There are few secure anchorages and groundswells are a seasonal problem during the fall and winter months.

The island of Montserrat consists of two volcanos and a high green saddle of fertile land in the center. The rich land was once considered the market garden of the Caribbean. The island has a rugged, indented coastline. There are a number of black volcanic beaches and one white sand beach in the north--Rendezvous Bay.

Montserrat is severely disadvantaged in terms of fisheries. It has one of the smallest Exclusive Economic Zones (EEZs) of all the Caribbean Islands. Although it is close to the Atlantic Ocean, no part of the Montserrat EEZ touches the Atlantic. Thus it has no Atlantic EEZ. In fact, the EEZ around Montserrat rarely extends more than 80 km off shore. Only in the Caribbean does the EEZ extend a greater distance offshore and even there the extension of its zone is impinged by that of Antigua (Redonda) and St. Kitts to the north and Guadeloupe to the south. Other islands including Antigua and Aves Island (Venezuela) further restrict the Montserrat EEZ.

Photo 3.--The steep fall-off of the coast into the sea can be seen here as well as a pyroclastic fan from a volcanic eruption deposited July 1987. Matthew Watson

C. Fishing grounds

The fishing grounds accessible to the small craft deployed by Montserrat fishermen are limited, although there are some productive offshore banks. Montserrat has an Exclusive Economic Zone of 21,100 square km, but the shelf area is very small--only 146 square kilometers.[16] This significantly limits the available demersal resource and even in the shelf area there are relatively few productive reef areas. The small open boats mostly under 8 m, operated by Montserrat fishermen, severely limit their access to productive offshore grounds. Many Island fishermen can only operate in coastal waters. More productive grounds offshore could yield tunas, king mackerel (kingfish), cavalli, jacks, and dorado (dolphin fish).[17]

Environmentalists report that the volcanic activity is affecting coral reefs between the east and southwest of the island. Some reefs have been buried by sediment and ash loads. One researcher in 1996 has documented sedimentation, coral bleaching, increased disease, and the disintegration of large sponges. Further coral reef damage was noted along the southern coast in 1997.[18] The degradation of the reefs will affect populations of reef species. Thus fishermen are not only being disrupted by the loss of port facilities, but habitat degradation will also affect yields on inshore grounds the fishermen had been targeting. Fishing areas have been restricted because of reef loss and the danger of possible loss of life.[19]

IV. Fleet

Montserrat's artisanal fishing fleet in the early 1990s was composed of about 80 boats. Most were under 8 meters and powered by outboard motors. [20] CARICOM indicates that the artisanal fleet in 1994 consisted of about 50 boats. The types of vessels included:

Dories: The Montserrat artisanal fleet is dominated by dories or locally constructed Boston whaler type boats. About 60 percent of the fleet is dories.

Cabin boats: About 12 percent of the fleet is small decked boats with cabins.

Pirogues: The Caribbean-style pirogue constitutes about 38 percent of the fleet.[21]

Montserrat has no significant commercial fishery. One longliner was operated in the early 1990s, but sank in 1992.[22] There are currently no longliners operating from Montserrat nor have the authors learned of any plans to acquire any. No information is available on recreational vessels.

V. Shipyards

Montserrat artisanal fishing boats were largely built by local shipwrights. The authors know of no shipyard on the island.

VI. Fleet Operations and Gear

A. Artisanal fishing

One local observer reports that several oceanic pelagics are available off Montserrat. Traditional fishermen in small boats were generally unable to access these species. [23] Artisanal fishermen in the 1990s reported catches of wahoo, kingfish (king mackerel), tunas, and barracuda. One fisherman reports particularly abundant catches of barracuda. He reports, however, that during 1999 no local fishermen actively targeted billfish.[24]

B. Commercial fishing

Montserrat fishermen have only limited experience with commercial longlining. A British consultant working in 1992 found that one Montserrat longliner was taking large pelagics off Montserrat and landing the catch on the island as well as neighboring islands. The vessel was reportedly active for 3 years. The vessel, however, sunk and there were no plans to replace it.[25]

C. Recreational fishing

Montserrat until 1995 held an annual billfish tournament focussing on marlin. A British consultant noted that Montserrat is located at the inner Atlantic corner of the Lesser Antilles and across some migration routes of game fish which enter the Caribbean. While noting that the lack of harbor facilities and tourist infrastructure disadvantage Montserrat, he concluded that the local hotels could promote sport fishing in a "relatively unexploited environment".[26]

The last Montserrat billfish tournament was held in 1995. The publicity about the Soufriere Hills Volcano has made it difficult to attract tourists and sport fishermen for subsequent tournaments. While the Volcano has attracted some venturesome eco-tourists, it has not seemed to have been a draw for sport fishermen.[27]

There appear to currently be few local opportunities for sport fishing on Montserrat. The authors have attempted to contact sport fishermen on the island. There are virtually no listings on the internet, unusual as most Caribbean islands have quite a few listings for sport fishing. One tourist hotel, the Rose Hill Guest House, suggested Cpt. Danny Sweeney, but he declined to provide any information on the local sport or artisanal fishery when the authors contacted him.[28] The authors have noted an internet posting of Sweeney landing a marlin.[29]

VII. Catch

The authors know of no Montserrat swordfish catch. Overall fisheries data are only rough estimates. Montserrat has been unable to institute a fisheries data collection system. Fishery officials report long lapses in which data has not been collected.[30] OECS provided some assistance in the 1980s to help create a fishery data collection system.[31] FAO changed historic catch data in 1999 (appendix A).

VIII. Ports

Montserrat's fishing industry is severely hampered by the island's extremely limited port infrastructure. The limited port facilities is one factor preventing fishermen from deploying larger vessels. The catch has been landed at about 8 sites around the island.[32] There is, however, an almost total lack of any sheltered harbor. As a result, boats that can not be beached, and are difficult to operate from Montserrat. Weather and sea conditions can be difficult around Montserrat. Storms cause fishermen and enforcement personnel operating the islands patrol boat to run to Antigua for safe harbor.

Carr's Bay: Carr's Bay was the second most

Photo 4.--View from a helicopter looking west across Plymouth just after the first flows started to destroy the town. The pier is visible in top right of picture. Matthew Watson

important fishing port in Montserrat before the volcano destroyed Plymouth and continues to be one of the two main ports. At Carr's Bay there are gear lockers and a covered area for gear storage and repair.[33]

Little Bay: An emergency jetty was built in 1996-97 for cargo and possible rapid evacuation should the need arise.[34] Fishermen were reported using the port in 1998.[35]

Old Road: Since the volcano destroyed Plymouth, more Montserrat fishermen have been working out of Old Road.

Plymouth: The principal city and port on Montserrat is Plymouth. The city is located on the southern half of the island. The old harbor quay at Plymouth was severely damaged by Hurricane Hugo in 1989. A $26 million construction program was completed in 1993, but did not include any facilities for fishing vessels--only commercial transport. A British consultant in 1992 found no plans for building necessary fisheries port infrastructure, such as a sheltered slipway.[36] Prior to the mid-1990s, over half of the islands's catch was landed at Plymouth. All of Plymouth was abounded and largely destroyed in the eruption of the Soufriere Hills Volcano during 1997.[37]

Other: Three Montserrat beaches have sheds to store fishing gear and even rudimentary sales facilities. Some fish is also sold in villages. Ice was available from the Government, but was reportedly expensive and of poor quality.[38] Even this may no longer be available. Presumably the ice making facilities were at Plymouth and destroyed in the 1997 Volcano eruption.

IX. Transshipments

The authors know of no swordfish transshipments through Montserrat. The almost total absence of even basic port infrastructure makes such transshipments unlikely.

X. Processing and Products

The authors know of no swordfish processing on Montserrat.

XI. Companies

The authors have little information about seafood companies on Montserrat. None are known to handle swordfish.

O.R. Kelsick: This company is one of the companies handling seafood. No information is available on the facilities or activities.

XII. Markets

A. Domestic

Seafood marketing is very rudimentary on Montserrat. There is a strong demand for seafood among the island's small population and customers can often be found at landing sites waiting for the fishermen to return.[39] Most of the catch is sold fresh at the beach landing sites, directly to consumers. It is sold as whole fish without any further processing. Crew members contribute toward the operating cost and then market their catch individually. Only when the supply exceeds the local demand on the beach is an attempt made to distribute the surplus to inland areas.[40]

B. Trade

1. Exports

There are no known Montserrat swordfish exports (appendix B). Fishery officials reported in the 1980s that the overall fisheries catch was not meeting the local demand for seafood.[41]

2. Imports

Montserrat imports seafood from other Caribbean islands. The authors know of no swordfish imports.

XIII. Government Policy

The agency responsible for Montserrat fisheries is the Fisheries Division in the Ministry of Agriculture, Trade, and Environment.

A. Law

The principal Montserrat fisheries law is the Fisheries Ordinance of 1979. CARICOM in 1997 help Montserrat and other Caribbean countries develop fishery management plans.[42]

B. Limits

The United Kingdom declared a 3-mile Territorial Sea in 1878.[43] This claim applies to all dependencies not covered by subsequent claims. The authors have no information concerning subsequent British actions specifically concerning Montserrat.

C. Licenses

The Montserrat Government authorized the Governor in Council to determine fishery fees and royalties.[44] There is, however, no licensing regulations issued nor are any under consideration. There is little information available suggesting that foreign fishing vessels operate in Montserrat's small EEZ. A 1993 British study suggested that the small coastal zone and lack of port infrastructure meant that few foreign vessels would be interested in purchasing Montserrat fishing licenses.[45] Montserrat is a member of the Organization of Eastern Caribbean States (OECS) which is encouraging member states to adopt a harmonized licensing regime.[46] While the OECS "pond" is broken up by non-member French islands (Martinique and Guadeloupe) among others, Montserrat waters would form a common zone with the neighboring OECS members to the north (Anguilla, Antigua, British Virgin Islands, and St. Kitts).

D. Promotion

The Fisheries Division beginning in the 1970s began to encourage fishermen to diversify and to shift fishing pressure to pelagic resources. A Japanese firm reportedly deployed a small purseseine in the 1970s and FAO through the WECAF project and did some test fishing.[47] The FAO Western Central Atlantic Fisheries (WECAF) project director also saw the exploitation of off shore pelagics with trolls, gillnets, and longlines as a key element in any expansion of the Montserrat fishing industry.[48]

Some subsidies are available to Montserrat fishermen. The Fisheries Division offers duty fee imports of fishing boats, gear, and related supplies to bona fide fishermen. There are also tax concessions, but not for boats. There is no fuel rebate.[49]

E. National consultations

Montserrat held national consultations during 1999 and 2000 for fishermen, vendors, Government officials, Coast Guard personnel, and other interested parties. Participants exchanged information on the status of stocks, fisheries development, the impact of the volcanic eruptions on fisheries, data collection, issues related to deep-sea fisheries, and other concerns. The consultations were sponsored by CFRAMP and financed by CIDA.[50]

XIV. Research

Montserrat does not conduct research on oceanic pelagics. There has been some limited data collected on inshore species. International organizations and environmental groups, however, have provided some assistance with collecting data needed for research and management.

CARICOM: The Caribbean Community's (CARICOM) Fisheries Resource Assessment and Management Program (CFRAMP) initiated a biological data collection program for large pelagics in 1995.[51] CFRAMP also organized the 1999-2000 national consultations financed by CIDA.

ICCAT: The authors know of no ICCAT research activities on Montserrat.

SEI: The Sustainable Ecosystem Institute (SEI) has been active on Montserrat, helping to assess the impact of the volcanic activity on the land and marine environment. SEI began a study of Montserrat's coral reefs in 1995. This coincided with the beginning of the Soufriere Hills eruptions and thus is providing useful data in assessing the environmental impact of the eruptions on inshore fisheries.[52] A detailed environmental assessment was prepared in 1996-97 of the Little Bay emergency jetty as well as mitigation suggestions. SEI was particularly concerned about the impact on coral reefs.[53]

XV. Bycatch

The authors have been unable to find little information about bycatch species on Montserrat. Time constraints associated with this project, however, have not permitted the authors to pursue this topic.

A. Tuna

The authors know of no significant tuna catch.

B. Billfish

Montserrat artisanal fishermen do not target billfish and there does no appear to be any appreciable recreational fishery. Artisanal fishermen, however, do occasionally take billfish, including blue marlin.[54]

C. Sharks

A FAO consultant in the late 1970s suggested that sharks were not heavily exploited and relatively easy to catch with mid-water longlines, although fishing effort would have to be strictly limited.[55]

D. Turtles

Turtle protection regulations were first issued in 1951.[56] Divers report seeing turtles.[57] There is some turtle nesting on Montserrat, but the authors have few details. Montserrat is located less than 100 km northeast of the important green turtle nesting site at Venezuela's Aves Island. SEI reported that initial plans to build an emergency jetty at Little Bay would affect a turtle nesting beach.[58]

E. Seabirds

An inventory of Caribbean seabird done in the 1980s suggested that two seabirds might nest on Montserrat (appendix C). The bird populations on neighboring Redonda are much more important.[59] Redonda is part of Antigua, but closer to Montserrat. One environmentalists reports that small birds are no longer being seen in numbers on the island.[60] The cause is unknown, but may be related to the volcanic activity.

XVI. International

A. International relations

1. Multilateral

The multilateral organization most concerned with Montserrat fisheries is OECS.

CARICOM: Montserrat participated in the Caribbean Community (CARICOM) Fisheries Resource Assessment and Management Program (CFRAMP). CFRAMP was not especially active on Montserrat, understandable given the small size of the fishery. CFRAMP did help develop a fishery management plan and an operating plan for a Fishery advisory Council, similar to those prepared for other member countries. CFRAMP ended in 2000 and was replaced with the Caribbean Regional Fisheries Mechanism (CRFM).[61]

ICCAT: The International Commission for the Conservation of Atlantic Tunas (ICCAT) is responsible for international coordination of research on and management of tuna and tuna-like species in the Atlantic, including swordfish. ICCAT has established catch limits and a variety of other conservation and management measures for many of the species under its purview. As a U.K. Overseas Territory, Montserrat interests are represented by the United Kingdom which is an ICCAT member.[62] The U.K. interest with ICCAT at past meetings, however, appears to have focused primarily on Bermuda and St. Helena. Notably, the small quota that ICCAT formerly provided the United Kingdom for Bermuda was changed for 2000-2002 to an overall quota for all the U.K. Overseas Territories (OTs). The authors do not know at this time how the United Kingdom will apportion this quota or the process involved. Several U.K. OTs conduct longline fisheries or have expressed an interest, but the authors have not noted any such interest on Montserrat.

OECS: Montserrat is a full member of the Organization for Eastern Caribbean States (OECS) and has adopted the OECS harmonized fisheries law and participates in the joint OECS fisheries enforcement program.

2. Bilateral

Montserrat has limited bilateral fishery relations. Taiwan has been the most active country reporting swordfish catches in the ICCAT 5° square encompassing Montserrat waters (Anguilla, appendix D and Anguilla, figure 5).

Cuba: Cuba has not deployed its longliners off Montserrat (Anguilla, appendix D).

Japan: The Japanese reported no billfish and other swordfish fishing off Montserrat during recent years. The last swordfish catches were reported in 1974 (Anguilla, appendix D). A fuller description of Japanese fishing operations in the northeastern Caribbean is available in the chapters of this report on Anguilla, Antigua, and the British Virgin Islands.

Spain: Spanish fishermen do not operate in the Caribbean (Anguilla, appendix D).[63]

Taiwan: Taiwan, like the Japanese, initiated Caribbean-area longline operations in the 1960s. The primary Taiwan activity has been to the north of the Caribbean, as far as Bermuda, where they have targeted albacore to supply Puerto Rican canneries packing "white meat" tuna.[64] Many of the vessels have operated out of St. Maarten.[65] Available evidence suggests that Taiwan longliners are not extensively fishing Caribbean waters, but are using Caribbean ports to transship their catch and maintain their fleet. Taiwan vessels in the mid-1980s began expanding transshipping activities out of Port-of-Spain.[66] The Trinidad-based vessels, however, do not appear to be the longliners targeting albacore to the north of the Caribbean. The Taiwan fishermen do not appear to be very active in the Caribbean itself, have been known to set opportunistically in waters adjacent to Anguilla and other Caribbean islands while in transit between their fishing grounds and Caribbean transshipment points. In the case of the Montserrat, this would be primarily the transshipment facilities at nearby St. Maarten. Some limited fishing activity has been reported in recent years (Anguilla, appendix D and Anguilla, figure 5). There have, for example, been occasional seizures of Taiwan longliners by the Marine Department (MD) of the Anguillian Police Force on nearby Anguilla.[67]

United States: The United States began developing a longline fleet targeting yellowfin tuna in the Gulf of Mexico. Beginning in the mid-1980s, U.S. longline fishermen started targeting swordfish after commercial stocks were encountered off the Florida Atlantic coast.[68] A small number of the swordfish/tuna U.S. longliners are active in the wider-Caribbean, including grounds to the north and east of Puerto Rico. The U.S. fishery is highly seasonal, primarily conducted during the winter months. U.S. pelagic longline fishermen in the Caribbean often fish in the northeastern Caribbean, but generally to the southeast of Puerto Rico, west of Montserrat.[69] One observer charges that much of the unlicensed fishing is conducted by U.S. fishermen. He claims that most of the unlicensed U.S. fishing in the area is done by fishermen off the west coast (south of Montserrat and Martinique).[70]

B. Foreign aid

A few foreign groups have provided limited foreign fisheries assistance.

Canada: Canadian Fisheries Consultants Ltd. (CFCL) helped set up a ice plant at Plymouth in 1985.[71] The Canadian for International Development Assistance (CIDA) assisted with a project to build artificial reefs. A test reef was built about 1 km off Plymouth.[72] CIDA in 1999 and 2000 helped finance national consultations on the status of fishery stocks and issues confronting the fishing industry.[73]

FAO: FAO though the WECAF project supported purseseine test fishing which also assessed other prospective fisheries, including longlining.[74]

United States: The U.S. Agency for International Development (AID) provided a grant for a fisheries consultant in 1985. He found that simple improvements in handling boats and nets, such as adding winches could make a big difference.[75]

C. Joint ventures

The authors know of no joint ventures involved with oceanic pelagic fisheries.

XVII. Enforcement

Montserrat, like the other U.K. overseas territories, has the legal right to control foreign fishing in its EEZs. This includes longline fisheries for oceanic pelagics in offshore waters. In practical terms, however, the islands find monitoring foreign fishing activities difficult, especially in the outer limits of their EEZs. Montserrat in 1992 had a patrol boat, but authorities reported difficulties in maintaining it. The vessel is maintained at anchor as there were no harbor facilities. When bad weather threatened, the vessel had to head for the open sea or to a neighboring island, usually Antigua, for shelter. A British consultant reports, "Such a practice is difficult, a constant worry and expensive, since a continuous watch must be maintained by an experienced coxswain."[76] The vessel was being used for two or three short inshore patrols per week. Very little attention was devoted to fishery activities. The vessel's limited operations accounted for 75 percent of all police vehicles on the island.[77]

XVIII. Future Trends

Montserrat had one of the most traditional artisanal fishing industries in the Caribbean. Artisanal fishermen in recent years have made some progress in developing fisheries for offshore pelagics. There is currently, however, no commercial fishing from Montserrat. The small island's small fishing industry has been decimated by volcano eruptions and hurricanes. One major limitation to the modernization of the fishing industry was the lack of a port for commercial vessels. A new port was built in Plymouth in 1993, but destroyed only a few years later by a volcanic eruption. The volcano has also forced the evacuation of Plymouth and the whole southern part of the island. This has sharply reduced the market available to the small number of fishermen who have continued to fish. Montserrat currently has no commercial longliners. The lack of a port and the small size of the EEZ suggest it is unlikely that Montserrat fishermen will acquire commercial longliners in the foreseeable future.

* * * * *

This chapter was designed and formatted by Kevyn Weiner, a senior at Walter Johnson High School in Bethesda, Maryland. He is a member of the Terrapin Anime Society (TAS), based on the University of Maryland College Park campus. He also currently has his A+ certification and is looking to earn more prestigious ones.

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SECTION XVI. (International)

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62. Individual European Union members are no longer ICCAT members. It was agreed at the 1997 annual ICCAT meeting that all EC Member States would withdraw from the Commission effective December 31, 1997. The sole exceptions were France and the United Kingdom which then rejoined in respect of their overseas territories.
63. See for example ICCAT, "1994 SWO background document: Figures," *op. cit.*, p. 91 and J. Mejuto, P. Sánchez, and J.M. de la Serna, "Nominal-catch per unit of effort by length groups and areas of the longline Spanish fleet targeting swordfish (*Xiphias gladius*) in the Atlantic, years 1988 to 1990 combined," *Collective Volume of Scientific Papers*, (SCRS/91/49) Vol. XXXIX (2) (ICCAT: Madrid, May 1992), pp. 615-625.
64. See the Bermuda chapter of this report for more details.
65. For details see the St. Maarten chapter of this report.
66. For details see the Trinidadian chapter of this report.
67. For details see "Enforcement" in the Anguilla chapter of this report.
68. Details on the U.S. swordfish fishery are available in Karyl K. Brewster-Geisz, "United States," *World Swordfish Fisheries*, Vol. V. (NMFS: Silver Spring, Maryland), pp. 63-102.
69. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1996," *NOAA Technical Memorandum* (NMFS-SEFSC-407), January 1998, p. 3 and Jean Cramer, "Large pelagic logbook newsletter - 1995," *NOAA Technical Memorandum* NMFS-SEFSC-394, November, 1996, p. 3.
70. Barreto, *op. cit.*, December 20, 1995.
71. Canadian Fisheries Consulting Ltd, "Plant and process projects summaries," internet site accessed September 4, 2001: http://www.canfish.com/canfish/plant5.html
72. Jeffers, "Status of ...," *op. cit.*, p.22 and McKinney, "Catching up ..., " *op. cit.*, p. 30.
73. CIDA, "Canadian cooperation in the Caribbean 2000 Edition: Montserrat," internet site accessed September 4, 2001
74. Giudicelli, "Purse seining demonstration ...," *op. cit.*, 33p.
75. McKinney, "Catching up ...," *op. cit.*, p. 29.

Section XVII. (Enforcement)

76. MRAG, "Large pelagic fisheries ...," *op. cit.*, p. 112.
77. MRAG, "Large pelagic fisheries ...," *op. cit.*, p. 112.

Appendices

Appendix A: Catch
Appendix B: Trade
Appendix C: Seabirds

Appendix A.--Montserrat. Fisheries catch, 1980-98

Year	Catch
	Metric tons
1980	109
1981	104
1982	111
1983	111R
1984	111R
1985	111R
1986	111R
1987	117
1988*	58
1989	28
1990	15
1991	32
1992	23
1993	58
1994	62
1995**	48
1996	38
1997	45
1998	46
1999	50F

Note: FAO in the 1999 *Yearbook* made major changes to the historic catch dated previously reported.
F - FAO estimate
* Hurricane Hugo struck Montserrat in 1988
** The Soufriere Hills Volcano erupted in 1995, devastating he southern part of the island, including Plymouth, the capital and main port.
Source: FAO, *Yearbook of Fishery Statistics.* (FAO: Rome, various years).

Appendix B.--Monserrat. Swordfish exports by destination, 1990-99

Destination	Year									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					Metric tons					
United States	-	-	-	-	-	-	-	-	-	-*
Japan	-	-	-	-	-	-	-	-		
European Union	NA	-	-	-	-					
Others**	NA	NA	NA	NA	NA					
Total	-	-	-	-	-					

* Through February
** Swordfish shipments to other countries are believed to be non-existent or negligible
Source: Various

Appendix C.--Montserrat. Seabird nesting, 1984

Area	Information	Species*	Known** threats	Importance***
Montserrat	Poor	3?, 5?	?, Pr?	Relatively unimportant
Redonda#	Reasonable	3?, 5?, 6?, 7?, 9, 10, 18?, 22	?, Ex?	Very important

Redonda is part of Antigua, but located closer to Montserrat
* Species: 3 - Puffinus I. lherminieri; 5 - Phaethon aethereus; 6 - P. lepturus; 7 - Fregata magnificens; 9 - S. sula; 10 - S. leucogaster; 18 - S. anaethetus; 22 - A. stolidus
** Threats: Ex - exploitation of eggs, young or adults; Pr - predators, generally introduced mammals; Ha - habitat destruction or disturbances; Po - pollution; Fi - fisheries
*** A rough subjective rating of relative importance of area for breeding seabirds.
Source: Ruud van Halewyn and Robert L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), "Status and conservation of the world's seabirds," *ICBP Technical Publication*, No. 2 (ICBP: Cambridge, 1984), pp. 175-176.

17

THE NETHERLANDS ANTILLES AND ARUBA

The Dutch Caribbean islands consist of two widely separated island groups. The Windward Group in the northeastern Caribbean is three very small islands with extremely limited fishing industries. The Leeward Group in the southern Caribbean is three larger islands with more substantial, but still mostly artisanal fishing operations. Antillian officials have for some years desired to expand the local fishing industry and longlining is one fishing method that they have considered. Increasing attention is being given to longlining for tuna, swordfish, and other oceanic pelagics, which the local fishermen in the past have not taken in quantity. The existing pelagic catch is mostly taken by trolling. Some officials are convinced that the future of the fishing industry lies with longlining pelagic species. There has been some test longlining. On Curaçao in the Leeward Group, one company in 1999 began experimental trials and in 2001 began full-scale commercial operations with a longliner imported from the United States. The company reports encouraging results. A second company began trials in 2001. A third company which has done some longlining may re-enter the fishery. Small-scale export shipments of fresh tuna and swordfish have been reported to the United States. The only known longlining operations are currently being conducted from Curaçao. On St. Maarten in the Windward Group, a Japanese company has for years operated a transhipment point for foreign, mostly Taiwan, longliners targeting tuna in the Atlantic. One report indicated that 24 large Taiwan longliners were working out of St. Maarten in 2000, although the number has varied somewhat over time. The albacore is shipped to Puerto Rican canneries. The tuna and some of the incidental billfish is marketed in Japan. Some of the billfish is sold in local Caribbean markets. Available information suggests that fairly substantial quantities of product is being transhipped, although less than through a similar transhipping center on Trinidad.

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Figure 1.--Map of the Dutch Caribbean islands showing both the Leeward and Windward Group of islands. These terms are a misnomer, however, compared to the actual wind patterns.

I. Overview

A. Background

The islands making up the Netherlands Antilles (N.A.) have a colorful history. Columbus discovered the Windward Islands Group in 1493. The Leeward Group (Aruba, Bonaire, and Curaçao) were discovered by Alonso de Ojeda in 1499. The Spanish did not take possession of the islands, however, until 1527. The Indians were largely enslaved to work South American gold and silver mines and Bonaire and Curaçao were largely deforested. The Dutch seized the islands in 1634 during their war of independence from Spain. In the 17th and 18th centuries the Dutch maintained their hold on the Leeward Group off western Venezuela, with the exception of British occupation during 1806-16. St. Maarten in the northwestern Caribbean Windward Group was another matter. It changed hands about 20 times. The Treaty of Paris ending the Napoleonic Wars confirmed Dutch possession of what is now known as the Netherlands Antilles and the islands became a part of the Kingdom of the Netherlands.

The Netherlands Antilles (N.A.) prior to World War II were Dutch colonial possessions. After the War, negotiations were held to confer a greater level of self government. The N.A. was granted internal self government in 1954 and became an integral part of the Kingdom of the Netherlands. Aruba separated from the rest of the Netherlands Antilles in 1986. The Dutch approved this separation with the idea that Aruba would move toward independence. Aruba has since reconsidered this step and remains and autonomous part of Kingdom of the Netherlands, but separate from the Netherlands Antilles.

Both the N.A. and Aruba have a parliamentary system of government. The Dutch Monarch is the head of state and represented in the N.A. and Aruba by an appointed Governor. Each island of the Netherlands Antilles also has an appointed lieutenant governor. The legislature is the Staten, popularly elected from the various constituent islands. The Netherlands Antilles and Aruba have separate Staten. Each is a unicameral body composed of elected representatives. The five island territories of the N.A. (Bonaire, Curaçao, St. Eustatius, St. Maarten, and Saba) are each governed by an island council.

The N.A. economy has changed significantly in recent years. The economy is now much more diversified.

Oil refining: The economic well being of the Netherlands Antilles for years depended primarily on the operations of oil refineries. The refineries import Venezuelan crude and ship refined product to North America and Western Europe. The volume of oil shipments have made Oranjestad and Willemstad and nearby facilities among the largest ports in the Caribbean.

Financial services: Offshore financial services, as on several Caribbean islands, as become an important economic activity.

Tourism: Tourism in recent years has become increasingly important. The Government has placed great priority on promoting tourism. Officials have, however, given less attention to managing the impact that tourism is having on the environment.[1] By 1985 tourism had replaced petroleum as the island's primary source of income. Some island's like St. Maarten are almost entirely dependent on tourism. Marine

Photo 1.--These Aruban boats are typical of the craft used by the local artisanal fishermen. Ron Rinaldo.

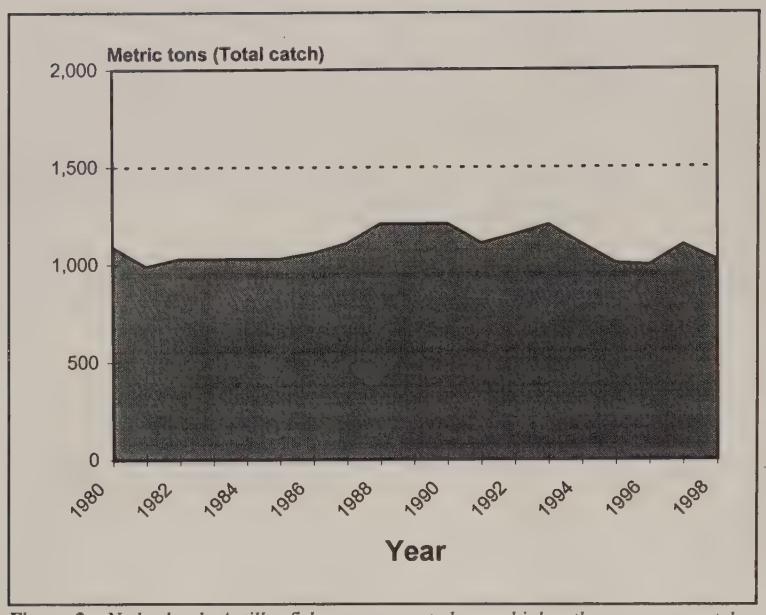

Figure 2.--Netherlands Antilles fishermen reported some higher than average catches in the late 1980s, but basically the estimated catch has remained little changed in recent years.

recreational sites such as beautiful beaches and diving sites are important attractions. The Netherlands Antilles has a more developed environmental community than is the case on many other Caribbean islands. The tourism industry is beginning to see common interests with environmentalists.

Fishing: The N.A.'s small fishing industry plays only a minor economic role, contributing less than 1 percent of the gross national product.[2]

B. Fishing industry

The Dutch Caribbean islands have only a small domestic fishing industry. The mostly artisanal fishermen conduct small-scale operations for primarily pelagic species. Some demersals are important on Aruba because of the islands larger shelf area. Demersals are also important in the Windward Group, but these fisheries are quite small. Handlining and trolling are the principal methods used, but other gear such as seines, spearfishing, and traps are also employed. One 1985 report indicated that there were about 100 full-time and 250 part-time fishermen on Curaçao. Data on the other islands was not available.[3]

Most of the fisheries catch reported by the Dutch Caribbean Islands is reported by Aruba and Curaçao. The Aruban catch has declined significantly in recent years, although that decline may be overstated because of inflated estimates of earlier catches.

Aruba: Aruba is located on the northern fringe of the South American (Venezuelan) continental shelf. As a result, demersal fish such as snappers and groupers are of greater importance than is the case for the N.A. (appendix B2b). Fisheries officials have reported a very sharp decline in the fisheries catch during recent years. Catches in the 1980s were reported at 500-800 tons. The current Aruba catch is only about 180 t annually (appendix B1a). This suggests a substantial decline. It is likely, however, that the reported 500-800 t 1980s catch estimates for Aruba were inaccurate and that actual catches were much lower.[4] A better idea of historic Aruban catches was probably the work done in the 1960s, for example, which estimated the Aruban catch at about 300 tons.[5]

Netherlands Antilles: The N.A. fisheries catch is dominated by that of Curaçao where most of the artisanal fishermen are located and over 80 percent of the catch is taken. The catch from the Windward Group in particular is quite small.[6] Much of the Curaçao catch is pelagic species (tuna, billfish, dorado, and wahoo) because the island is located in deeper water than Aruba at greater distance from the Venezuelan shelf. Pelagic species are more abundant in the deeper water around Curaçao. One 1981 assessment indicated that nearly half of the Curaçao and Bonaire catch was tuna and wahoo.[7] Current data indicates that the importance of these

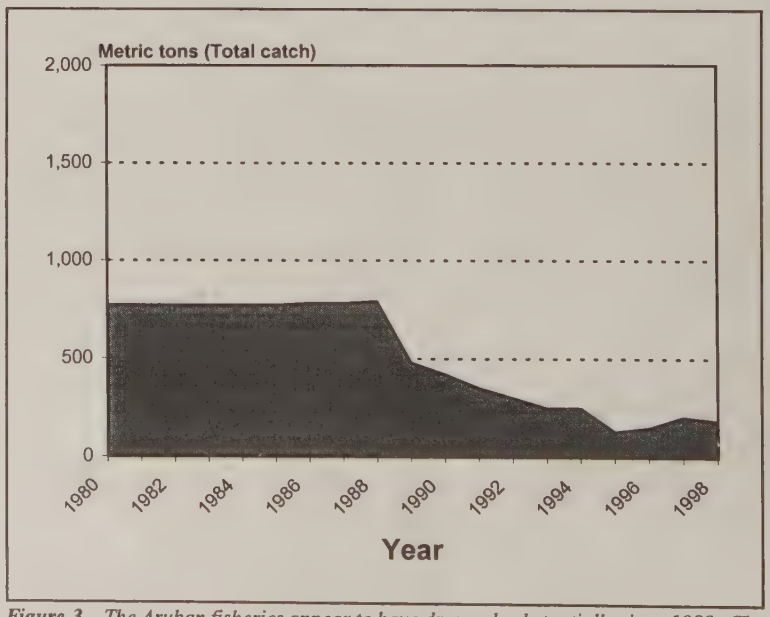

Figure 3.--The Aruban fisheries appear to have dropped substantially since 1989. The actual decline may be less severe as some observers believe historic catches were not nearly as large as estimated.

species has continued (appendix B2a1). Demersal species are of greater importance in the smaller Windward Group, but the catch from these small islands makes only a minor contribution to the overall N.A. catch and is affected by ciguatera.[8] N.A. officials have also reported a catch decline in recent years from 1,200 in 1990 to only about 1,000 t in 1998 (appendix B2a1). Over the longer term, however, catches appear more stable (appendix B1a). The authors stress that the Netherlands Antilles has not had a fisheries data collection system. As a result, historical data is largely rough estimates, based on occasional annual sampling.

The small catch of the local artisanal fishermen does not fully supply the domestic demand for seafood. Both the N.A. and Aruba import sizeable quantities of seafood. The growing tourist industry in particular, requires a substantial quantity of seafood and species that can not be supplied locally. Trend patterns differ from island to island.

Aruba: Aruba also imports seafood. One NMFS official visiting Aruba in 2001 reports that few tourist restaurants offered locally caught fresh seafood.[9] Import data shows that shipments are highly variable. Imports in the early 1990s ranged from $5.2-7.3 million, but dropped to $1.9-2.0 million in 1994-95. Imports in 1996-98 have ranged from $16.2-17.6 million (Caribbean Overview, appendix F1a). Most of the large quantity of imports since 1996 have been fresh or frozen fish. Exports are generally minimal, normally ranging from nil to $0.1 million. Shipments in 1997, however, totaled $0.6 million (Caribbean Overview, appendix F1b). They were mostly crustaceans and mollusks.

Netherlands Antilles: The N.A., as recently as 1995, imported $10.6 million of seafood. Imports declined, however, to only $3.5 million in 1998 (Caribbean Overview, appendix F1a). About $6.4 million worth of seafood was imported in 1999. Quite a variety of commodities are imported, but the most important product is fresh or frozen fish. One report indicated that snapper was a particularly important item, but a variety of shellfish such as lobster and shrimp for tourists were also being imported. Import patterns have been affected by domestic price controls.[10] Some exports may actually be transhipments, fish landed by foreign longliners in St. Maarten. N.A. exports have normally been limited, but in 1996 exceeded $1 million. Shipments in 1998 were only slightly below $1 million (Caribbean Overview, appendix F1b). Exports are mostly fresh or frozen fish.

Officials, fishermen, and environmentalists in the Dutch Caribbean have expressed concern about the fishing industry. Some of the major concerns are:

Pollution: Officials have reported concern about pollution.[11] Some positive steps, however, have been reported in recent years. Garbage is no longer dumped in the sea on the major islands.[12] Effluent from the sewers once flowed without treatment into the sea in areas near to the respective towns. Some progress is also being reported in the treatment of effluent.[13]

Habitat: Officials are also concerned about habitat loss.[14] Mangrove areas in particular are being lost to land development.[15] The mangrove estuaries are important breeding and nursery areas for many marine species,

Longlining: Some recreational fishermen have expressed concern about the impact of foreign and developing domestic longlining on billfish and other stocks.[16]

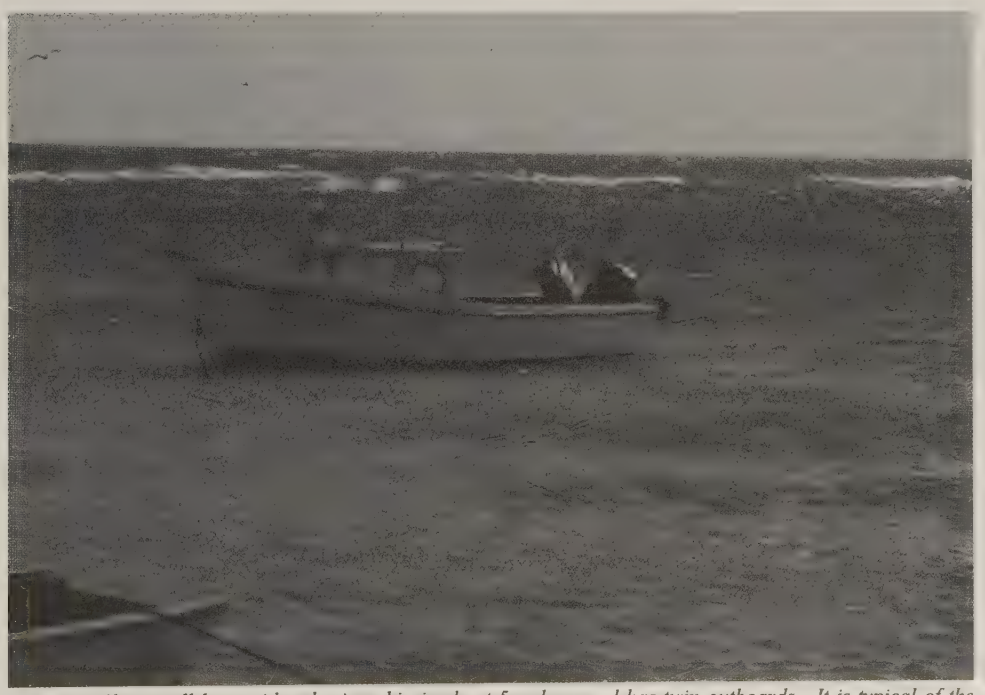

Photo 2.--This small boat with a basic cabin is about 5-m long and has twin outboards. It is typical of the boats used by artisanal fishermen on Aruba. Ron Rinaldo

II. Species

The authors could find virtually no published information on swordfish behavior off the Dutch Caribbean Islands. There is no local research on swordfish underway. Domestic fishermen on Curaçao have just begun to target the species. Asian longline fishermen have taken tuna, billfish, and swordfish for many years. Some limited Asian activity still continues to the west of Aruba out of Colombian ports. The authors, however, know of no published reports from the Asian longline operations describing swordfish behavior in the western Caribbean.

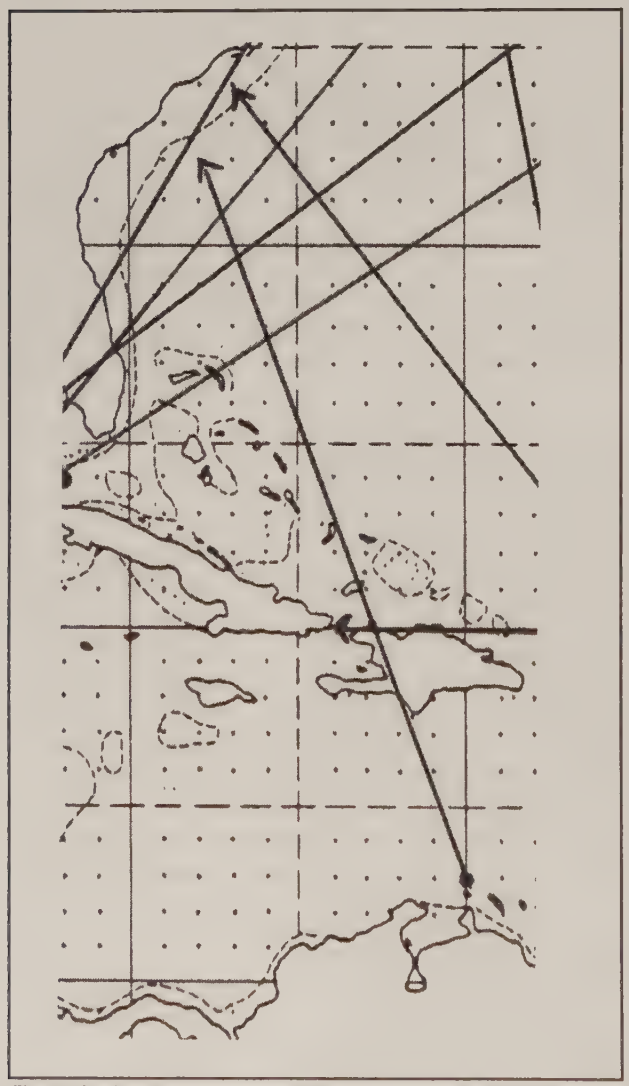

Figure 4.--Only one tag return is available from the NA Leeward group. One juvenile swordfish was tagged north of Aruba and over 3 years later retrieved off the U.S. coast east of Georgia.

The spawning grounds for swordfish are primarily deduced by the location and abundance of swordfish larvae. One 1983 study reported that there is relatively little spawning within the Caribbean itself, although some limited spawning does take place south of Cuba. There is much less abundant larvae in the southern Caribbean, including the waters around the Netherlands and Aruba.[17] A 1998 analysis shows a similar pattern of notable larval concentrations in the Gulf of Mexico and U.S. southeastern coast, but little or no larval concentrations in the southern Caribbean off the Leeward Group of Dutch islands and Venezuela (Venezuela, figure 10).[18] Information on larval concentrations around the Windward group are discussed in the chapters on the other northeastern Caribbean islands.

Some limited tagging results are available which provide some possible insights into swordfish behavior. **Leeward group**: The authors have noted only one swordfish tag return around the Leeward group (Caribbean Overview, appendix C3). The one tag return (R216431) from the area around the Leeward Group, shows that a swordfish was taken north of Aruba and then retaken off the U.S. coast, east of Georgia over 3 years later (Caribbean Overview, appendix C3). This swordfish was only 4.5 kg when tagged, but nearly 50 kg when recaught. The movement is in accordance with the view that the southern Caribbean may be a nursery area and that swordfish move north out of the Caribbean to feed on richer grounds along the U.S. and Canadian coasts. **Windward group**: Tag returns from the northeastern Caribbean near the Windward group are more numerous. One interesting observation is that the further west the swordfish were tagged in the wider-Caribbean, the more likely they were to be retrieved off the U.S. coast. The further east they were tagged, beyond the Antillian Arc into the Atlantic, the more likely they were to be retaken east of the Grand Banks. A similar phenomenon can be observed for swordfish making south bound migrations (Anguilla, figures 3 and 4). These returns are discussed in the Anguilla, Puerto Rican and other nearby island chapters and thus will not be repeated here.

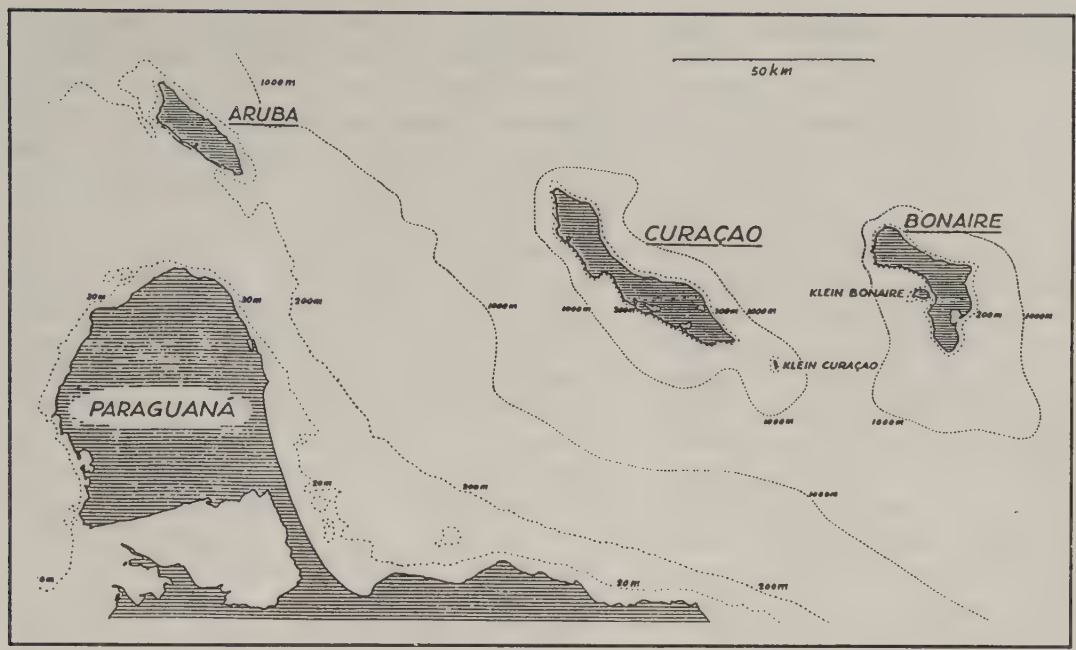

Figure 5.--Map of the Dutch Leeward island group. Note that Aruba is on the South American shelf, very close to Venezuela's Paraguaná Peninsula. Van Buurt

III. Grounds

A. Topography

The Dutch Caribbean islands are composed of two widely separated island groups. The Leeward Group is composed of three relatively large islands, Aruba, Bonaire and Curaçao, located about 100 km north of the western coast of Venezuela. The Windward Group is located about 880 km to the northeast in the Antillian arc. It is composed of the three small islands of Sint Eustatius,[19] Sint Maarten[20], and Saba. Dutch jurisdictions extends to only half of St. Maarten, the remainder is French. All of the Dutch islands are volcanic in origin and thus have generally steep coasts and resulting narrow shelves.[21]

Leeward Group/Southern Caribbean: The Leeward Group is made up of the three largest islands located off the western coast of Venezuela. The name is a misnomer because the prevalent wind regimes is closer to that of the Windward Islands in the Lesser Antilles.[22]

Aruba: Aruba is the most westerly of the Dutch islands. It is located about 70 km west of Curaçao, but only 25 km off the coast of Venezuela. Wide sandy beaches exist along the southern coast. The soil is rocky and there is even less vegetation than Curaçao. Aruba's location on the South American shelf provides a much greater area of shallow-water grounds than is the case of Bonaire and Curaçao. The water between Aruba and Venezuela is less than 110 m at its deepest point. Much deeper water separates Aruba from the other two Dutch Leeward islands, Curaçao and Bonaire. The depth in places exceeds 1,350 meters.

Bonaire: Boomerang shaped Bonaire is located 40 km east of Curaçao. It is the second largest island. Bonaire is famous for its flamingo colony and extensive salt ponds. The northern part of the island is mountainous while the south is relatively flat. All around the island the 200-m isobath is found less than 2-km from the shore. This means that the island shelf is very narrow and the drop-off steep. The eastern and northeastern slope offers a somewhat gentler slope than along the western coast. The sea floor along the eastern and western coasts are generally rocky and covered with sea grass. The western shelf is more rocky and dominated by madrepores and corals.[23] Bathymetric charts show depths of 1,500 meters between Bonaire and Curaçao and 1,000 m between the Aves and Los Roques archipelagos.[24]

Curaçao: Curaçao is the largest of the six Dutch islands. The population is concentrated in the capital of Willemstad. Several bays indent the southern coast. One bisects Willemstad, making an excellent natural harbor. The island is low and hilly and is of volcanic origin. The climate is arid. Like Bonaire the island shelf is narrow with a steep drop-off. The sea along the north coast is very rough access is difficult for many of the smaller fishing vessels, especially the fishermen targeting reef species with handlines.[25] Despite the dangers, a few fishermen in 2001 are fishing reeffish with handlines along the north coast. They operate from a small fishing port called Playa Canoa.[26] Curaçao and some of the other islands have important areas of seagrass which are critical marine habitat for turtles and other species.[27] Some of these

areas are now included within marine parks. Some research on these areas has been conducted.[28] In contrast to Aruba, relatively deep water separates Curaçao and the Venezuelan coast, water as deep as 1,350 meters.[29]

Windward Group/Lesser Antilles: The Windward Group is composed of the three smaller islands located in the northeastern Caribbean. The name is a misnomer because the islands are located within the Leeward Islands of the Lesser Antilles.[30]

St. Eustatius: St. Eustatius is of volcanic origins and relatively undeveloped. The population is centered in Oranjestad. The central part of the island is flat, ideal for agriculture.[31] There is an inactive volcano on the southern end of the island. Most of the shore is rocky and steep. There are a few sandy beaches and no wetlands. St. Eustatius lies on a relatively shallow shelf which it shares with St. Kitts.

St. Maarten: The largest island in the Windward group is St. Maarten, but only the southern half is administered by the Dutch. The northern part of the island is controlled by France. The Dutch population is centered in Philipsburg. The island is mountainous and has greater rainfall and vegetation than the Leeward Group. There are a few saline lagoons. St. Maarten is located on the same shelf as Anguilla. Because of the location on the southwest corner of the Bank, St. Martin can claim only a tiny share of the Anguilla Bank and its abundant fishery resources.

Saba: Tiny Saba is located 40 km southwest of St. Maarten. It is an extinct volcano rising dramatically out of the sea about 870 m to the summit of Mt. Scenery. Steep rocky terrain make farming difficult. Within the crater, however, vegetation is lush. There are scant sheltered bays along the rocky coast and Saba is one of the few Caribbean islands without a beach. There are also no wetlands. The shelf around Saba is extremely narrow and falls off exceptionally steeply. Depths exceeding 500 m are found within 1 km of the coast. There are, however, two nearby sea mounts rising to only 30 m below the sea surface.

The two Dutch island groups are also situated quite differently in connection with the Caribbean basins and thus the distance from deep water varies.

Windward Group: The Dutch Windward Islands lie on the interior of the northeastern Caribbean arc. They thus have no projection into the Atlantic and the deepwater located outside the arc. All three islands are located well north of the Grenada Basin and at some distance east, more than 100 km, of the Venezuelan Basin. All three islands lie on the northern extension of the Aves Ridge close to the especially shallow water of Saba Bank.

Leeward Group: The Leeward Islands are located on the southeastern fringe of the Venezuelan Basin. The Beata Ridge leading to Hispaniola and separating the Colombian and Venezuelan Basins is located well to the northwest. To the north the water becomes quite deep. This is especially true off Bonaire where depths of 3,700 m are only about 30 km to the northeast. While water to the south is more shallow, there is an area of deepwater southeast of Bonaire called the Bonaire Basin. The water south of Aruba is especially shallow as the island sits on the Venezuelan shelf.

B. Oceanography

The authors have noted few oceanographic studies of the waters around the Dutch Caribbean islands.

Leeward Group: The dominate oceanographic feature off the Leeward Group is the Caribbean Current which flows westward north of the islands. This current is less pronounced than more well known currents and is

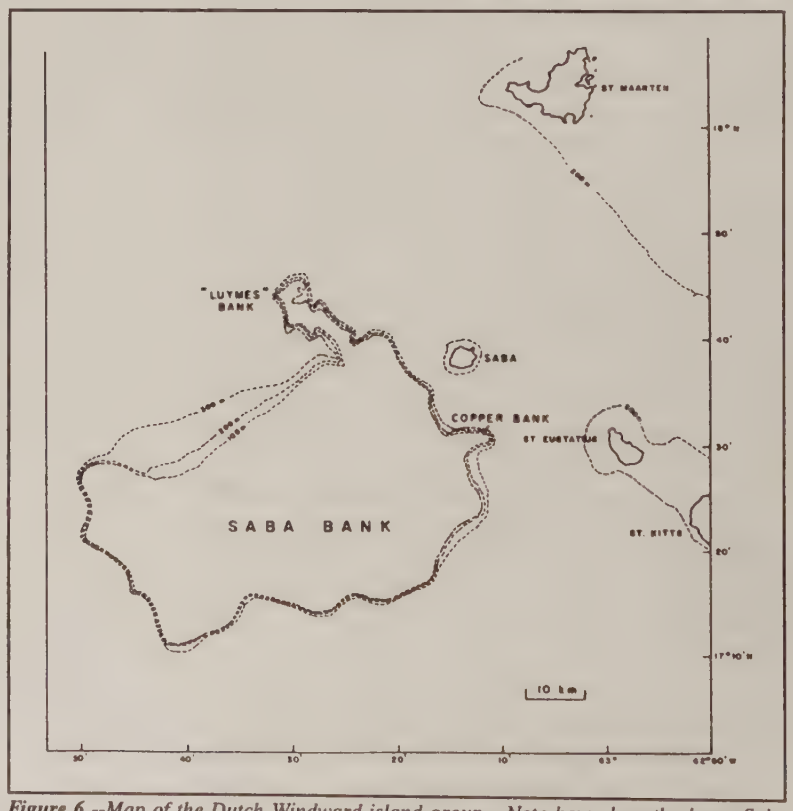

Figure 6.--Map of the Dutch Windward island group. Note how close the large Saba Bank is to Saba Island. St. Eustatius shares the Anguilla Bank with St. Kitts and St. Maarten. Van Buurt

discussed in more detail in the Venezuelan chapter of this report. Venezuela has in recent years pursued a range of oceanographic studies, some of which have included the water around the Dutch islands, especially the Leeward Group off the western coast. One of the subjects of greatest interest to the Venezuelans has been upwelling.[32]

Windward Group: The important Anegada Passage between the Atlantic and Caribbean is located well to the northeast of the Dutch islands. The authors have not noted any oceanographic studies particularly referencing the islands of the Dutch Windward Group. Some information on the oceanographic conditions off these islands is available in the chapters on several neighboring islands, especially Anguilla and Antigua.

The wind regime of the two island groups are distinct, but the popular names generally used for each group are confusing, especially when discussing wind conditions. The Leeward Group is in fact located in the southern Caribbean where wind conditions are more like those of the Windward Islands. The Windward Group on the other hand is located in the middle of the Leeward Islands.

Leeward Group: The Leeward Group (Aruba, Bonaire, and Curaçao) is outside the hurricane belt and severe storms are relatively infrequent compared to the Windward Group. The Leeward Group, however, is not unaffected by Caribbean hurricanes.[33] Trade winds blow constantly from the east.

Windward Group: The Windward Group (Saba, St. Eustatius, and St. Maarten), however, does regularly experience severe hurricanes.

C. Fishing grounds

The fishing grounds available to fishermen in the Leeward group are quite distinct.

Aruba: Aruba is located on the edge Venezuelan shelf. There are thus extensive shallow-water areas accessible to Aruban fishermen, especially off the southern and western coasts. As a result, fisheries for demersal species are important.

Bonaire and Curaçao: While still located relatively close to Venezuela, both Bonaire and Curaçao are located off the shelf. The water around the islands is deep and the islands own coastal shelf very narrow. As a result, even the small coastal craft deployed by the fishermen take pelagic species.[34] FAO consultants reported that the clearness of the water presented problems in designing fishing gear.[35] Fishermen targeting oceanic pelagics operate in the deeper water to the north of the island. The water to the north can be quite rough, requiring a fairly substantial boat.[36] This has made it somewhat more difficult for Antillian fishermen to enter the longline fishery than is the case for fishermen on some other Caribbean islands.

Fishermen on the Windward Group also report varied operations.

Saba: Saban fishermen primarily focus on Saba Bank. (See "Saba Bank" below.)

St. Eustatius: St. Eustatius (Statia) fishermen primarily fish on the narrow island shelf. The fish around the island are considered generally safe, but barracuda and amberjack are avoided. There are occasional trips in good weather conditions to the southeastern area of Saba Bank, but this makes only a small contribution to the overall catch. Certain areas are avoided because of ciguatera. The island is located about 30 km from Saba Bank. The return trip has to be made against the prevalent direction of current and waves with the boat laden down with fish. This is very difficult in a small boat.[37]

St. Maarten: The small number of St. Maarten fishermen primarily fish close to the island which is

Photo 3.--The small boats used by most fishermen on the Dutch Caribbean islands means that fishing is largely conducted very close to the coast. Ron Rinaldo

located on Anguilla Bank. The Dutch side of the island has only a small area of shelf.

The Windward Group have larger available shallow-water banks than the Leeward Group.

Saba Bank: One of the major grounds open to fishermen in the Windward Group is Saba Bank, an undersea elevation with a large, shallow flattened top located southwest of Saba and west of St. Eustatius. Areas of the Bank along the eastern side are as shallow as 7-15 meters. About a third of the Bank lies within the territorial sea of Saba Island and the remainder within the jurisdiction of the N.A. central government. The Bank is mostly fished by fishermen from Saba. Ciguatera is a serious problem on Saba Bank. Most fishing takes place on the northern and northwestern part of the bank along the drop-off areas. The central area of the Saba Bank is sandy and not very productive.[38] The northeastern, especially Copper Bank is one of the areas most affected by ciguatera.[39] Some southern areas of Saba Bank are also affected ciguatera.[40] N.A. officials believe, however, that pelagic fisheries could be expanded and that even some demersals are safe because the northern and northwestern part of the Bank does not appear to be severely affected by the toxin.[41] Saban fishermen in the early 1980s were only taking about 50 t of fish annually on the Bank, but complained about foreign (Anguilla, St. Kitts, U.S. Virgin Islands, and Venezuela) operations. The Bank is now actively patrolled by the Netherlands Antilles and Aruba Coast Guard. N.A. officials believe that it was being overfished. Only Antillian fishermen with a permit are now allowed to fish o the Bank. About 50 Saban fishermen currently operate in the Bank, primarily targeting lobster and to a lesser extent snapper.[42] Saba Bank has intrigued scientists who have differed as to its origins. A Dutch expedition in 1974 concluded that Saba Bank was a submerged, but living atoll--among the largest in the world.

Anguilla Bank: St. Maarten is on the same shelf area as Anguilla, but the Dutch share of the Bank is limited by its location on the southern half of St. Maarten and the fact that the island is on the southwestern edge of the bank.

IV. Fleet

A. Domestic

Available information on the fishing fleets active on the Dutch Caribbean islands include the following:

1. Artisanal

The fishing fleet on each Dutch island is composed almost entirely of artisanal or small-scale commercial boats.

Aruba: A 1981 report indicated that the fleet consisted of 4-7 m boats, often powered by twin outboards, which are mostly used for handlining.[43] One 1988 report indicated that there were about 140 boats (4.5-6.0 m) involved in trolling and net/trap fisheries.[44] A visitor in 2001 reported seeing mostly small, long narrow wooden boats. Most were open boats. Only a few had cabins. Some had pipe fittings to hang shade awnings.[45]

Bonaire: A 1981 report indicated that fishing vessels on Bonaire were similar to those used by Curaçao fishermen.[46]

Curaçao: A 1981 report indicated that fishermen mostly operated two different types of boats. Small 3-4 m boats were deployed along the coast for

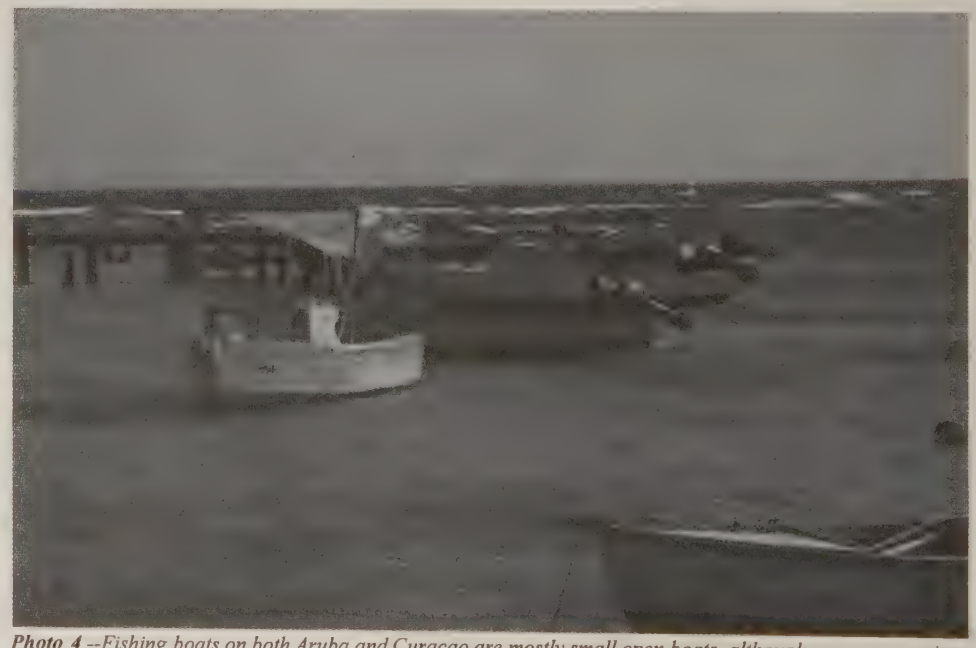

Photo 4.--Fishing boats on both Aruba and Curaçao are mostly small open boats, although many are equipped with powerful outboards. Ron Rinaldo

handlining, small seines, and a few traps. Larger boats with diesel motors were used for surface trolling. Officials reported that the diesel motor fleet consisted of 32 inboards (over 9 m), 45 inboards (7-9), 52 inboards and outboards (5-7 m), and a number of outboards under 5 meters.[47] Artisanal fishermen in 1988 operated about 185 trollers, ranging from about 7-10 meters. Only a few boats were involved in demersal fishing.[48] Data compiled by Curaçao officials indicated that the fleet in 1994 was composed of 255 boats over 5 m, about 150 in the 5-9 m categories (appendix A1a1). Officials note that the number of boats have doubled since 1979 and the increase in the larger category (over 9 m) has been especially significant.

Saba: A 1981 report noted 15 small boats (up to 5 m), 4 medium boats (5-7 m), and two larger boats (7-9 meters).

St. Eustatius: A 1981 report indicated that there were about 10 boats: 3 boats (4 m), 6 boats (5 m), and 1 boat (6 m).

Photo 5.--There are several sport fishing charter operators with well equipped boats on both the Dutch and French sides of St. Maarten. Cornie Mazurier/Marine Time

2. Commercial

The authors have noted few commercial fishing boats operating from the Dutch islands. One company, Blue Caribbean Seafood on Curaçao, conducted experimental longline operations in 1999 and 2000 and in 2001 initiated full-scale operations with a steel-hull longliner imported from the United States (appendix A2c).[49] A few other longline operations have been reported with smaller boats, but these do not appear very successful at this time.

Some information is available on individual longliners which have been operated from Curaçao and Bonaire.

Bigeye: The *Bigeye* was acquired in late 2000 and was operating from Curaçao in early 2001. It is a purpose-built 19-m steel hull longliner, recently purchased in the United States. It is operated from Curaçao by Blue Caribbean Seafood. As longlining operations are still quite new to the crew, the vessel is just beginning to perfect operations. The catch is both exported and sold locally.[50] The vessel was in drydock for a few weeks in June-July 2001.[51]

Driekiel: This longliner was deployed in 1999 by the Dutch Fondelgroup, but was only 12 m which proved too small for the rough water to the north of the islands where the best fishing for oceanic pelagics is conducted. It also experienced many technical problems. Blue Caribbean purchased much of the catch from four trips in 1999, but the results were disappointing.[52] The vessel was transferred to St. Maarten, but is not operated as a longliner there.

Make My Day: This longliner is a 14.5 m converted yacht. It was also deployed in 2000 out of Curaçao. The crew is also quite new and the vessel, as a result, still does not go out regularly. The catch is sold locally. Some observers believe that the vessel is too small for operations in the open Caribbean. One observer also believes that the winch is placed too high.

Raven: The 18-m *Raven* was deployed out of Bonaire for a short time in 1999. The catch was sold to Blue Caribbean Seafood. *Raven* has been inactive for some time, but the owner in 2001 asked to renew his expired fishing license. He may re-enter the fishery.[53] The boat in July 2001 was in drydock under going repairs.

3. Recreational

Several of the Dutch islands have active recreational fisheries. The available fleet and facilities are best on the islands with the larger tourist industries. The authors know of no inventory of sport fishing boats on the different islands, but the following boats are a representative sample.

Aruba: Aruba has a large, well equipped recreational fleet. One visitor in 2001 reported many recreational boats capable of offshore operations. Many have outriggers so they can pull multiple lines.[54] Several operators on Aruba offered fully-rigged boats capable of deep-sea operations for tourists. Boats have fish recorders, sounders, radars, and different weight Penn International and Shimano rods and reels. Teaser Charters has two 11-m Bertram sportfishermen, *Teaser* and *Kenny's Toy*. Other deep-sea boats range from the 10-m *Lucky Star* to the 12-m *Thaisa* and 13-m *Mahi-Mahi*. The *Rainbow Runner* is a 13-m cabin sports yacht specializing in bottom fishing. More than 15 other well-equipped deep-sea sports boats are available.[55]

Bonaire: Several operators have modern, well equipped sport fishing boats. Big Game Sportfishing operates the 9-m Hatteras *Delfin*.[56] Another operator offers the 12-m Bertram *Siri*. Quite a number of smaller boats are also available.[57]

Curaçao: Several sport fishing boats are available on Curaçao, although one local reported that they "tend to come and go". One 2001 report noted several sport fishing boats ranging from the 5-m *Hemingway* to the 16-m *War Eagle*. Other boats include the *Seascape*, *Just Us*, and *Heavy Duty*.[58]

Saba: There is only a small fleet on Saba. The 10-m *Albian* is available for sport fishing as well as diving and other pleasure activities.[59]

St. Eustatius: The authors have no information about sport fishing boats on St. Eustatius.

St. Maarten: Several charter operators offer well-equipped boats like the 10-m *Freedom*.[60]

B. Foreign

1. Foreign flagged

Longliners from several different countries have landed their catch at St. Maarten. Most of the vessels were operated by Korean and Taiwan fishermen, but the Korean fishermen ceased operations about 1985. A few Venezuelan longliners also appear active.

Taiwan owned: As of 2000, there were 24 older Taiwan-owned longliners operating from St. Maarten (appendix A3). One report indicates that the foreign longliners based in St. Maarten are mostly older, refurbished Japanese-built vessels.[61] Another source suggests that they are mostly built in Taiwan shipyards. One observer described the longliners as older, not very well maintained vessels. Available information suggests that some of the vessels were built in the 1980s, but the authors can not confirm this because most of the vessels did not appear on available vessel listings.[62] Some may be newer vessels built as recently as 1997 (appendix A3).

Taiwan flags: Detailed information is available only on two of the Taiwan-owned longliners at this time. They were sister ships built in Taiwan during 1985. Both were 49-m long and 440 GRT (appendix A3).

Flags of convenience: Many of Taiwan-owned longliners operating from St. Maarten apparently have flag-of-convenience registrations. Several vessels are registered in Belize and Honduras, and one vessel is registered in Equatorial Guinea (appendix A3).

Photo 6.--Many of the Taiwan-owned longliners operating from Trinidad and St. Maarten are flagged in other countries. Notice the St. Vincent flag on one of these Trinidad-based Taiwan longliners. D. Weidner

Confirmed details on these vessels, however, are unavailable. For some unknown reason, most of the vessel names published by St. Maarten port authorities do not show up on available vessel listings. Part of the problem may be difficulties associated with the transliteration of Chinese characters, but there may other factors as well.

Venezuela: While most of the longliners working out of St. Maarten appear to be Taiwan owned, a few longliners appear to be Venezuelan owned. Unlike the other vessels which are mostly Taiwan owned, these are not flag-of-convenience registrations, but actual Venezuelan-flagged vessels. The Chimana vessels appear to be Venezuelan owned and flagged, although only the Chimana Grande is on available vessel lists (appendix A3). The vessels are reportedly owned and operated by Pesquera de la Isla, based in Puerto la Cruz. The Guanta vessels may also be Venezuelan-owned, but less information is available.

2. Flag-of-convenience registrations

Foreign tuna purse seiners have been registered under the Netherlands Antilles flag. Antillian officials point out that they have a 50-year history of flagging vessels and the Antillian Government maintains a well known register in the maritime world.[63] One officials insists the Antillian flag is in effect the Dutch flag, only the place of registration being different.[64] This is similar to Bermuda and the Caymans, two British overseas territories which also maintain vessel registers. Only a few of the vessels flagged by the Netherlands Antilles are fishing vessels.

1973-80: Foreign tuna fishermen registered some tuna purse seiners in the Netherlands Antilles during the 1980s (appendix A2a). The vessels were sold in 1980-81, mostly to Mexican companies which were expanding their tuna fleet.

1998: A Green Peace report indicated that 16 large flag-of-convenience fishing vessels were registered in the N.A. during 1998. The vessels averaged over 1,000 GRT each.[65]

1999- : The only foreign fishing vessels seiners currently operating with Netherlands Antilles flags are Spanish-owned seiners operated by the Overseas Tuna Company. These vessels were first registered in 1999 (appendix A2b).

The N.A. Department of Economic Affairs (DEPEZ) is responsible for reporting N.A. fishery catches to ICCAT. This would mean the catch of all fishing vessels flying the N.A. flag, including the foreign-owned tuna vessels. The problem is that DEPEZ has not been receiving the data from the foreign-owned seiners. The foreign owners agreed to provide data, but have not done so regularly. The current N.A. Fisheries Law applied only to territorial waters and the Exclusive Fishing Zone (EFZ).[66] As a result, the foreign vessel owners are under no legal obligation to supply this information. N.A. officials are aware of this difficulty. They have concluded that it is not feasible to amend the existing Fisheries Law as it is specifically focused on fisheries in territorial waters and the EFZ and on delineating the responsibilities of the N.A. central and island governments. Officials believe that an entirely new law is required, but this will take several years to enact.[67] The authors note that at the 2000 ICCAT meeting that the N.A. representative did submit tuna catch data for the flag-of-convenience vessels.[68]

The flag-of-convenience vessels have proven to be a contentious issue within the N.A. Government. Officials in DEPEZ (which is responsible for fisheries in the N.A. central Government) has concerns about flagging foreign fishing vessels. Some N.A. fishery officials see little benefit from registering foreign fishing vessels and a variety of possible complications from international organizations, like ICCAT, as well as environmental groups. The foreign owners, however, work directly with Scheepvaartinspectie Nederlandse Antillen (SINA) which actually registers the vessels. The Spanish tuna companies operating the seiners would like for the N.A. to join ICCAT so that they could fish under a N.A. quota. They have apparently convinced SINA to promote the question of ICCAT membership within the N.A. Government. The Spanish companies which own the flag-of-convenience tuna seiners have reportedly offered to pay

Photo 7.--Foreign-owned tuna seiners have operated under the NA flag. Most never actually came to Dutch Caribbean ports. This Venezuelan-owned seiner, however was photographed in Oranjestad. Alfredo Pichardo

the cost of N.A. membership, quota fees, and the cost of attending the meetings. DEPEZ does not agree and contends that accepting Spanish funds creates a serious conflict of interest.[69]

There appears to be some conflicting information and misunderstanding about the registration of the foreign fishing vessels. Some officials seemed convinced that substantial sums are generated for the N.A. treasury. Others insist that the registrations are a drain on the treasury, but do benefit some individuals. Available information, however, suggests that the N.A. Central Government pays much more as a result of the registrations than the treasury receives in fees or taxes.

Limited fees: One official maintains that the registrations of relatively small fishing vessels result in very limited fees because the fee structure was set up for lager cargo vessels and tankers. The fees for the nine Spanish seiners in 1999 was NAf 14,000, about $8,000.[70] No steps have been taken to adapt the rate structure to fishing vessels.

Few jobs: The offshore company operating the vessels employs only two people, the director and secretary, both located on Curaçao.

Little revenue: One N.A. official reports that as of 2000, the company had not paid any income taxes.

Administrative expenses: Some reports suggest that the N.A. Government actually incurs substantial administrative expenses which are not covered by the fee payments.

Technical inspections: The vessels have to be inspected annually (technical inspection) by SINA. The company pays the air fare, hotel, and per diem expenses for the N.A. inspectors. As the vessel do not fish out of or land their catch in the N.A., the inspectors have to travel to the vessels. Even so, there are overhead expenses for the SINA inspectors whose salaries are paid for by the N.A. Central Government.

Health inspections: An additional health inspection is now required as a result of EU sanitary rules. The cozy relationship administered by SINA for the vessel technical inspections was not acceptable to the EU because payments to the inspectors were an obvious conflict of interest. As a result a special foundation was established for the inspectors. The fishing company contributes to the foundation, the foundation pays the inspectors, and the N.A. Central Government in effect subsidizes company operations.[71]

Despite the apparent substantial net financial outlays as a result of the registration of the Spanish seiners, some N.A. officials support the program. SINA officials in particular advocate the continued licensing of the program and make statements to the press that describe millions of dollars in revenue. Ex-SINA Minister Maurice Adriaans appeared on television describing the millions of NA florins in revenue that foreign-flagged operators could generate. He indicated that his party (FOL) was in favor of joining ICCAT despite possible repercussions to domestic fishermen. Other officials more concerned with the domestic fishermen believe that membership in ICCAT would result in a quota that could unduly limit the developing domestic longline operations.[72] SINA contends, however, that the potential revenue from registering foreign vessels is potentially more significant. The foreign operator working through SINA has promoted ICCAT membership hoping to get access to a potential N.A. quota allocation.[73]

V. Shipyards

Most fishing boats operated by Antillian fishermen are small, locally constructed wooden boats. They are built in small craft yards on Curaçao, and to a much lesser extent Bonaire (appendix A1b). The authors have only limited information on these yards. None are capable of building commercial longliners.

Antilliaanse Jachtwerf: The Antilles Small Craft Yard on Curaçao worked on a wide range of barges and small boats including fishing boats. They had two slipways. The larger slipway has the potential to service small craft up to 300 GRT.[74] A 1981 report indicated that almost all boats used by the fishermen were wooden vessels constructed locally. The company went bankrupt a few years ago and its operations were taken over by a new company.

Bonaire Jachtwerf: The Bonaire Small Craft Yard has operated on Bonaire for several years. The Yard apparently still operates, but may have a different name.

Curaçao Dry Dock: Ship repair work is much more extensive than vessel construction. The main facility is the Curaçao Dry Dock.

E Meta Korsou: One source describes this Curaçao firm as a "jachtwerf" which means a small repair or construction facility. It was the old Antillian Small Craft Yard operated by former employees. It also has gone bankrupt.

Only a few boats are imported, mostly from the United States, the Netherlands, and Venezuela (appendix A1b).[75] The only really successful longliner currently in operation, *Bigeye* was imported from a U.S. (Louisiana) shipyard.

VI. Fleet Operations and Gear

A. Domestic

1. Artisanal

N.A. and Aruba fisheries are essentially artisanal in character, but some fishermen conduct small-scale commercial operations.

Aruba: Aruba's relatively wide shelf supports a much larger reef fishery than is the case off Curaçao. One 1979 report indicated that the fishermen were mostly handlining.[76] A subsequent report indicated that the Aruba fishermen were both trolling for pelagics as well as trap and net fishing. Fishermen, according to a 1988 report, did not target billfish due to the limited market and low prices received for them.[77] A 2001 report indicated that the troll fishermen catch wahoo, small tunas like albacore, dorado, king mackerel, bonito, and a variety of other species.[78]

Bonaire: Fishery officials report that fishing operations are largely pelagic and similar to those conducted on Curaçao.[79]

Curaçao: Fishermen pull troll lines and to a lesser degree set traps and use beach seines. A 1979 report indicated that much of the catch was dorado, kingfish, and wahoo. Some tunas are taken, primarily skipjack and blackfin which the fishermen call "buní". Yellowfin and marlins are also reported.[80] A more recent report indicated that tunas and wahoo comprise nearly half the catch. Other important species include: billfish (5 percent), rainbow runner (10-15 percent), dorado (15 percent), and reeffish (10-15 percent) (appendix B2a2).[81] The narrow shelf significantly limits demersal fisheries.[82] There are, however, some snappers, groupers, and other demersals landed. There is no special fishing season, but fishermen report that dorado fishing is best in March and May and bonito (skipjack and blackfin) best from March to May and September and October.[83]

Saba: Saba fishermen mostly operate on the northern and northwestern part of nearby Saba Bank. Most fishing is by handlines, but spears and traps are also used. The catch is mostly demersal species like snappers and groupers as well as grunts, parrotfish, and jacks. The catch is largely marketed in nearby St. Maarten where there is a larger population and a substantial tourist industry.[84]

St. Eustatius: Statian fishermen mostly operate near the island, occasionally venturing to Saba Bank. They use handlines and traps. An American buyer in the 1980s was purchasing the lobster catch and flying it to St. Croix in the U.S. Virgin Islands thus yielding the Statian fishermen better prices than those available on Saba.[85]

St. Maarten: The authors could not find a description of the St. Maarten fishery. The economy of Dutch St. Maarten is oriented to the tourism industry. The artisanal fishing that does take place is primarily conducted from the northern French side of the island on the Anguilla Bank.[86] There is, however, a very small artisanal fishery on the southern St. Maarten side of the island. Fishermen deploy a variety of gear, including traps and nets.[87]

Photo 8.--The NA longliner "Big Eye" is the most successful local attempt at commercial longlining. They deploy a 40-65-km line and set the hooks about 50 m deep. Craig Theriault

Photo 9.--The longliner "Big Eye" reported good catches of tuna and swordfish on its first trips in early 2001. Subsequent catches on grounds north of Curaçao were disappointing. Craig Theriault

2. Commercial

The N.A. does not have a significant commercial fishery. Most of the catch is landed by the artisanal fishermen. The largest fishing operation is Blue Caribbean Seafood on Curaçao which deploys one longliner. Two other Curaçao operations are attempting commercial operations.

Blue Caribbean has reported the most successful results, but they only began commercial operations in 2001 and are still experimenting with different fishing strategies. The company reported excellent results through March in the initial sets with its new longliner *Bigeye*, but then water temperatures increased and catches plummeted (appendix B3c). Blue Caribbean targets swordfish and tuna, both yellowfin and bigeye. The catches are about equally divided between swordfish and tuna.

Trips: They plan trips of about 5 days which allows 5 sets because they have been fishing close to Curaçao, usually 30-130 km north of the island. They decided that limiting trips to 5 days would ensure that a quality product was being delivered. As they are just beginning their longline operations, trip length has varied, but at least initially they are planning on 5 days.

Line: They set a 40-65 km line with about 15-20 hooks per kilometer. The hooks are spaced at about 60 meters. The hooks are set at depths of about 50 m, but this can vary with the sag of the line. The buoy line is about 28 m and the hook lines about 22 m deep. About 6 hook lines are set for each buoy.[88]

Baits: Blue Caribbean started using both mackerel and squid for bait. They have since stopped using mackerel as it did not appear to be effective. They are now using squid, but plan to try live bait using a fish available locally.

Light sticks: The company puts a light stick on each hook line. They report that without the lightsticks there is rarely a fish hooked. The captain has no color preferences, just wants the brightest color possible.[89]

Sets: The line is set beginning about 6-7 pm in the evening. They tend to let the line soak longer than many longline operations. They begin to haul the line in about 8-9 am in the morning and often do not complete the process until 4-5 pm in the afternoon. Even after long soaks, many of the swordfish are alive when brought aboard. The company believes that this is evidence that they are producing a very high quality product.[90]

Shark damage: There is considerable shark damage because of the long soaks, but the company believes it increases the tuna catch. They believed that sharks are primarily responsible for the damaged carcasses. They observe line movement which appears to be shark activity--sharks playing with the baits. In addition they have not observed large numbers of pilot whales or other cetaceans known to feed on longline catches.

Bycatch: The primary bycatch is shark. Many are a species called mako locally. The Canadian captain reports, however, that it looks different than the makos that he is familiar with. One blue shark has been taken along with hammerheads. The hammerheads are generally discarded, but the other sharks are retained.[91]

3. Recreational

Recreational fishing is a popular activity in the Netherlands Antilles, especially the islands with a substantial tourist industry. Diving appears to be a greater attraction than fishing on the Dutch islands. There are many important coral reefs around the various islands and these are attractive spots for divers.[92] Curaçao alone has over 100 different diving sites. The clear water on St. Maarten and other islands provide wonderful diving experiences. There are also sport fishing opportunities on each island. Several tournaments are held on the different islands. Charter operators offer trips which target marlin (blue and

white), sailfish, dorado, barracuda, wahoo, amberjack, king mackerel, bonito, tuna (blackfin and yellowfin), and other species. The species targeted varies seasonally and by boat type. Operators with small boats will usually focus on inshore demersals. There are also differences from island to island as to the availability of each species. Only one sport charter operator, Teaser Charters on Aruba, is known to target swordfish.

Aruba: Aruba hosts the Classic International Fishing Tournament. It is one of the oldest in the Caribbean and sponsored by the Aruba Nautical Club. The 32nd annual event was held October 24-27, 1998 at Orangestad. Aruba also hosts the International Billfish Tournament. It is sponsored by the Bucuti Yacht Club. The 24th event was held November 1-3, 1998, also in Orangestad.[93] Sport fishermen report taking blue marlin and sailfish as well as dorado, wahoo, and other species.[94] One Aruba company, Teaser Charters, offers swordfish trips along with charters for billfish and other gamefish. This is apparently the only charter on any of the Dutch islands offering swordfish trips. They stress that taking a swordfish is quite a challenge and report that the best fishing for swordfish is from mid-August to February. They work the Aruba drop-offs at night (7-11 pm) in water 300 m or deeper. Swordfish are taken at 40-55 meters. Teaser always releases the billfish and was the first on Aruba to adopt this policy in the early 1980s.[95] Some sport fishermen on Aruba have reported that catches of billfish have declined markedly in the past 1-2 years.[96]

Bonaire: Bonaire sport fishermen sponsor the International Fishing Tournament in March. Several operators offer both deepsea and reef fishing. Some of the major operators are Big Game Sportfishing and Piscatur. One captain in 1998 reported 20 years experience in working with sport fishing and stresses tuna fishing.[97] Another operator in addition to the regular daytime trips offered night fishing for sharks and other species.[98] Operators report deepsea fishing only a mile off the island. Several of the operators are IGFA members and release all billfish. A group called Fishing Bonaire helps anglers arrange charters with some of the smaller operators.[99]

Curaçao: There are sport fishing opportunities on Curaçao, but the industry appears dwarfed by the much larger diving industry. Much of the activity occurs at Spanish Water, a large lagoon near the eastern end of the island which is the island's boating and fishing center. Curaçao sport fishermen at the Curaçao Yacht Club sponsor the International Blue Marlin Tournament which is held in March or April. The 35th annual tournament was held March 15-18, 2001. The tournament has a conservation focus and all billfish under 91 kg (200 lb) must be released.[100]

Saba: The authors have little information about sport fishing on tiny Saba. The one operator we found reports opportunity for both reef and blue water fishing.[101]

St. Eustatius: The authors have no information about sport fishing on St. Eustatius.

St. Maarten: Recreational fishermen report that marlin are much more common than sailfish, but there is occasionally some intensive sailfish activity. White marlin are also taken.[102] St. Maarten's tourist industry supports several charter operators. One of the most important tournaments is the St. Martin/St. Maarten Annual Big Fishing Tournament.[103] A local recreational fishing club sponsors the annual International Blue Marlin Fishing Tournament during June.[104]

Photo 10.--Sport fishermen on St. Marten/St. Martin take a variety of species, but blue marlin is what most anglers would like to catch. Cornie Mazurier/Marine Time

Some anglers want to retain part of their catch, especially if they have accommodations with kitchen facilities. Most boat operators allow anglers to keep their catch if they so desire--often with the exception of billfish which is commonly released. This is not, however, always the case

and should be confirmed with the boat captain prior to making a reservation. The catch if retained cannot be sold.[105] A permit is needed when fishing from vessels larger than either 12 m or 6 GRT. If the boat uses no more than 4 troll lines and no other fishing gear, an exemption is made.[106] Some captains have arrangements with local restaurants who will cook an angler's catch at a special price.

B. Foreign

The Foreign longline fishermen chartered by the Japanese deployed longlines 65-80 km in length with about 1,500-1,800 hooks. They make trips averaging 4-5 months.[107] These long trips means that virtually all of the fish transhipped through St. Maarten is frozen product. This contrasts with the Taiwan operation in Trinidad where a great deal of fresh product is also landed and transhipped. More detailed information about Taiwan fishing operations and methods is available in the Taiwan chapter of this report.[108]

VII. Catch

Fishery officials have reported for some time that the Netherlands Antilles does not have adequate fishery statistics. Some attempts have been made to estimate catch levels. A 3-month study was conducted in 1968. New calculations were made in 1978-79.[109] The lack of reliable fisheries data has severely limited fisheries management.

The Curaçao Fisheries Section in 2001 reports setting up a data collection system. The Curaçao Government (Dienst LVV) starting January 2001 began collecting data from the Curaçao traditional fishery. The Fisheries Section after years of requests finally obtained funding for this effort.[110] Historic data is only rough estimates based on number of boats and some work by Gerard Van Buurt done in the 1970s. The preliminary results of the data collection suggest that catches have declined, but it is premature to reach any conclusions because pelagic fisheries can vary widely both seasonally and from year to year. The Fisheries Section has also not yet collected data from the 2001 peak pelagic season. Officials were surprised to find that rainbow runner which used to be present all year round and constituted 5-15 percent of the catch is now almost completely absent (only about 1.4 percent). Another surprise is the large quantity of wahoo being caught, nearly 35 percent of preliminary landings.[111]

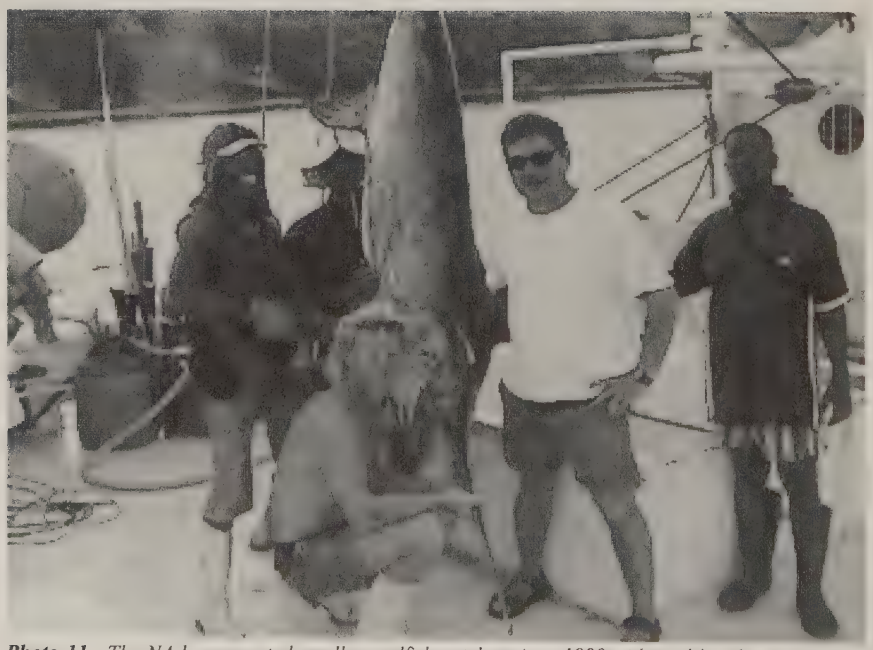

Photo 11.--The NA has reported small swordfish catches since 1999 with trial longline operations. The 2001 catches may be somewhat larger as a result of actual commercial operations. Craig Theriault

The Netherlands Antilles reports only minimal swordfish catches. Swordfish is not a species traditionally taken by Antillian fishermen, despite the presence of swordfish in the waters around the Dutch islands. Curaçao officials report, for example, only three reports of swordfish catches by artisanal fishermen in the past 25 years. While the artisanal fishermen do report yellowfin catches, swordfish catches are quite rare. The reported tuna catches are small, consisting of fish landed by the artisanal fleet. The catches of the foreign-owned vessels registered in the N.A., mostly tuna purseseiners, are generally not recorded as part of the Netherlands Antilles catch by FAO. Presumably the data is not supplied by the Netherlands

Antilles Government. Theoretically a vessel's catch is reported as that of the flag country, but this does not appear to happening in the case of the Netherlands Antilles. ICCAT does not even publish Netherlands Antilles fleet or catch data.

The authors have only limited annual information about catch and related trends in the N.A. fishery for oceanic pelagics.

1980s: The United States reported swordfish imports from the Netherlands Antilles. As much as 42 t (1982) were shipped. The authors have no details as to the source of these shipments. In some years the shipments (1981-82 and 1985) were mostly frozen, this was probably the bycatch of the Taiwan tuna longliners. In other years shipments were mostly fresh (1986-89), this may have been transhipments from U.S. tuna longliners (appendix D2a1a). Taiwan tuna longliners transhipped tuna through St. Maarten throughout the 1980s. Most of the tuna has been albacore destined for canneries on Puerto Rico (appendix D2b3). The level of shipments, however, was highly variable, ranging from $0.1 million (1983) to $14.4 million (1980) (appendix D2a1a). Taiwan was the major supplier of albacore to Puerto Rican canneries. Albacore shipments to the Puerto Rican canneries through St. Maarten at the end of the decade in 1989 totaled over $12 million (appendix D2b1).

1990: The United States imported 8.5 t of swordfish in 1990. This probably was transhipments by a U.S. swordfish longliner (appendix D2a2). Fewer Taiwan longliners transhipped through St. Maarten than in prior years.[112] Minimal Taiwan tuna transhipments of only $0.1 million were reported to the United States in 1990 (appendix D2b1).

1991-93: The United States imported 2 t of swordfish in 1992. This probably was transhipments by a U.S. swordfish longliner (appendix D2a2). Taiwan transhipped only minimal quantities of tuna to the United States. Shipments in 1992 were negligible and nil in 1993 (appendix D2b1)

1994: Taiwan resumed tuna transhipments to the United States in 1994, but the value was still less than $1.0 million (appendix D2b1). The last major swordfish shipments to Europe were reported in 1994 (appendix D4). The authors are not sure, however, that such shipments actually stopped. It is possible that the EU changed their statistical system and started counting the transhipments as imports from Taiwan. N.A. officials as late as 1999 were noting shipments to the EU (Germany).[113]

1995: Taiwan tuna transhipments to the United States in 1995 increased to nearly $6 million (appendix D2b1).

1996: The United States imported 12 t of swordfish in 1996. This probably was transhipments by a U.S. swordfish longliner because it was fresh product (appendix D2a2). Taiwan increased tuna transhipments for the United States to over $14 million (appendix D2b1).

1997-98: Taiwan transhipped $18-19 million worth of tuna annually in 1997 and 98 to the United States (appendix D2b1). Small swordfish shipments were reported to Europe in 1998 (appendix D4)

1999: The Dutch Fondelgroup initiated longline trials with the *Driekiel* in late 1999. Blue Caribbean Seafood on Curaçao purchased much of the catch.[114] The *Driekiel*, however, proved too small for longlining oceanic pelagics. A variety of technical problems were also experienced after only a few sets. Some swordfish, however, was taken (appendix B3c). The *Raven* was operated from Bonaire.[115] Both sold their catch to Blue Caribbean. No actual catch data is available, but some export data has been tabulated by N.A. officials, from which approximate catch data can be computed. About 260 kg of swordfish taken by *Driekiel* are believed to have been exported in 1999.[116] This would mean about 370 kg live weight (appendix B3a). It is likely that small additional quantities may have been sold domestically.

2000: Taiwan transhipped nearly $16 million worth of tuna annually through St. Maarten to the United States in 2000 (appendix D2b1). Taiwan was the principal country supplying albacore to the Puerto Rico canneries. The St. Maarten shipments, however, were only a fraction of overall Taiwan shipments.[117] Officials report that the pelagic troll catch has declined, although catch data does not exist to accurately assess trends. Some officials believe that declining catches may be simply the normal substantial swings occurring in many pelagic fisheries. Others believe that increasing foreign effort on many species is affecting Antillian catches.[118] Blue Caribbean acquired the commercial longliner *Bigeye* in the United States during late 2000.[119] Three trial runs were conducted which permitted exports of about 315 kilograms (appendix B3c).[120] This would mean a catch in live-weight of nearly 450 kg (appendix B3a).

2001: Blue Caribbean deployed the *Bigeye* in more regularized operations in 2001 and has reported some successful operations as the crew gains experience.[121] It is thus likely that the N.A. will report a small swordfish catch in 2001. Another company is using *Make My Day*. Both companies are working with new crews and thus are just beginning to develop effective fishing practices.[122] *Make My Day* has made such trips close to Curaçao, but is not yet regularly deployed on fishing operations. Blue Caribbean ha, however, reported some successful sets with *Bigeye*.[123]

VIII. Ports

Dutch Caribbean fishermen operate from a small number of landing sites on each island. The largest number is located on Curaçao where much of the NA fisheries catch is landed. Most of the sites can not be accurately described as fishing ports with developed facilities for the fishermen. Most Antillian fishermen land their catch at very basic landing sites. The most developed facility is Caracasbaai Visserhaven on Curaçao. The developed facilities at recreational marinas on the Dutch islands contrasts with the minimal facilities at most landing sites used by the fishermen.

Few developed fishery ports exist in the Dutch Caribbean islands. Many fishermen used ports with minimal facilities are even undeveloped beach sites. Available information on landing sites on the individual Dutch islands are as follows:

Aruba: The principal port is Oranjestad. Fishermen operate from two principal sites on Aruba. There are also a few scattered wooden piers or other limited facilities for the fishermen at various locations along the island. A small number of fishermen operate from these sites.[124] There are also several marinas on Aruba.

Bonaire: The principal port is Kralendijk. Fishermen operate from three sites.[125] There are several marinas on Bonaire with good facilities.

Curaçao: The principal port is Willemstad. Most of the port, however, is devoted to cargo and cruise ships. The artisanal fisheries catch is landed at several bays and small harbors located all along the coast.[126] One source noted seven different sites of importance. A recent report from Curaçao listed 11 principal landing sites ("visserhavens") and indicated several other minor sites were used (appendix A1a2). The most important is Caracasbaai. There are two sites at Caracasbaai, the visserhaven proper and a smaller nearby site. Nearly half of Curaçao's fishing boats over 5 m operate from these two sites (appendix A1a2). The rest of the fleet operates from much smaller sites. None of the other sites are frequented by even 20 boats over 5 meters.[127] There are also several marinas on Curaçao. Curaçao officials are concerned about the safety of the small fishing boats operating from Caracasbaai when, as expected, the traffic of large cargo vessels increases. The expansion of the Curaçao fleet (appendix A1a1) has meant the increasing use of the limited facilities at Caracasbaai. Officials are considering other sites for a possible new fishing port. Santa Martha along the west coast is one possibility. There are many conflicts between the small fishing industry and the more important tourist industry and other interests over the use of available coastal sites. Officials believe that centralizing fleet operations by constructing a new fishing port would prove very beneficial to the fishermen. Not only could needed facilities be built and services offered, but other problems such as vulnerability to theft, a problem at small isolated sites, could be effectively addressed.[128]

Saba: The principal port on Saba is The Bottom. Saba fishermen mostly operate out of Fort Bay on the southwestern coast. A few small fishing boats are also based in Cove Bay. The northern area of Saba Bank area within easy reach of Fort Bay.[129]

St. Eustatius: Fishermen mostly operate from Oranjebaai.

Photo 12.--This is the small artisanal landing site ("viisserhaven") Sta. Martha on Curaçao and is typical of many such landing sights in the Leeward Group. Gerard Van Buurt

Photo 13.--This is one of several small landing sites used by artisanal fishermen on Aruba. Ron Rinaldo

St. Maarten: The principal port on the southern, or Dutch side, of St. Maarten is Philipsburg. A major expansion of the port is being planned. Fishermen operate from only two sites, at Great Bay (Philipsburg) and Simpson Bay. The island, however, has many marinas for sport fishermen. One report indicated that there were 11 marinas on St. Maarten/St. Martin, including both the Dutch and French sides of the island. Simpson Bay Lagoon is one of the best sheltered marina in the Caribbean for recreational boats. It is located between the main Dutch and French cities and is the location of the best yachting facility on the island. Some fish is landed there near the government-sponsored market. The marina facilities at Simpson Bay are operated by the Sint Maarten Yacht Club.[130]

Photo 14.--The principal port on the southern, or Dutch side, of St. Maarten is Philipsburg. A major expansion of the port is being planned. Dennis Weidner

Photo 15.--A number of foreign longliners, like U.S. boats at Oranjestad on Aruba during 1987, have transhipped small quantities of tuna and swordfish through the Dutch Caribbean islands. Alfredo Pichardo

IX. Transhipments

The Netherlands Antilles is an important transhipment point for foreign longliners. The principal location is St. Maarten. There also appears to have been some limited activity out of Aruba and Curaçao, but officials know of no current transhipping other through the Dutch Caribbean islands other than that occurring on St. Maarten.

A. Islands

1. Aruba

Some limited foreign transhipping has been reported through Aruba.

Taiwan: Some Taiwan longliners were reportedly transhipping through Aruba in 1986-87. One local environmentalist reports seeing container loads of yellowfin tuna, marlin, and big wahoo. He reports that the Taiwan fishermen were operating with a mother ship and smaller longline catcher boats. He worked with the environmental group the National Coalition for Marine Conservation. An ABC film crew came down from the United States to film the operation.[131] The Taiwan fishermen stopped the transhipments, according to the local environmentalist, because of all the bad publicity. He charges that some poor-quality fish was being shipped and then claims were made on the insurance.[132]

United States: U.S. longliners operating in the Caribbean during the 1980s also used Aruba as a transhipment point. The Merrit fleet was particularly active there. One NMFS observer during a 1988 visit noted the *Miller Time* and the *Miller Time II* in port. An Aruban environmentalist reported discussing operations about 50 km north of the island with the captain of the U.S. longliner *My Toy* who was transhipping in 1987.[133] Officials reported that other U.S. longliners (*Alicia Mary, The Beginner, Bobby Dale, Dealer's Choice, Nancy J, No Problem*, and *Uno Mas*) were unloading there. They were mostly unloading swordfish. No billfish landings were reported.[134]

There does not appear to have been any transhipping through Aruba during the 1990s. Local observers have not reported any foreign transhipments since the late 1980s.[135]

2. Curaçao

U.S. longliners in the 1980s occasionally called at Curaçao to obtain fuel and supplies. Some reportedly landed their marlin bycatch.[136] The authors have no further indications about transhipping

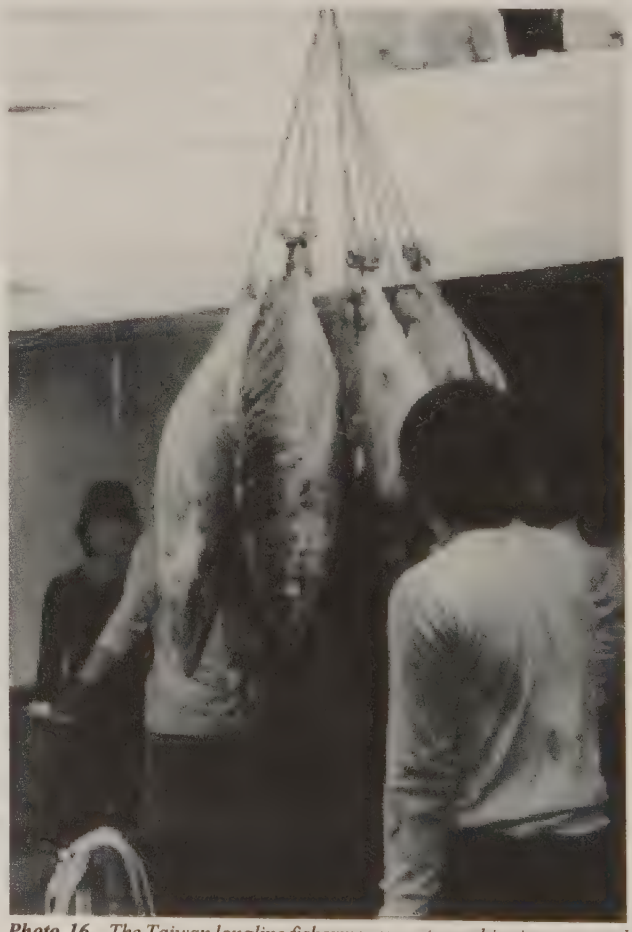

Photo 16.--The Taiwan longline fishermen were transshipping tuna and swordfish through Oranjestad during 1986-87. Alfredo Pichardo

through Curaçao. Officials in 2001 report that there is no transhipping through Curaçao. One official reports, however, that he has noted quantities of wahoo on the Curaçao market. He is unsure if it is product landed by Taiwan longliners in St. Maarten or perhaps bycatch from Venezuelan longliners.[137]

3. Bonaire

The authors know of no transhipping through Bonaire.

4. Saba

The authors know of no transhipping through Saba and consider it unlikely because of the limited port facilities and lack of any substantial fish processing and handling facilities.

5. St. Eustatius

The authors know of no transhipping through St. Eustatius and consider it unlikely because of the limited port facilities and lack of any substantial fish processing and handling facilities.

6. St. Maarten

A Japanese company (Nichirei) operates a transhipment facility at Philipsburg. The name has changed over time. Initially it was Curaçao International and Curaçao Pioneering. It is currently Nichirei Carib. The authors are unsure as to just what was involved in the various name changes which could have involved changes in ownership. Foreign longliners transhipped their catch through these facilities during the 1980s.[138] Transhipments continued in the 1990s.[139] One 1991 report indicated that the distant-water longliners were increasingly using other Caribbean ports.[140] The authors have noted transhipping activity in particular at Port-of-Spain, Trinidad. This appears to be expanded transhipment activity rather than a displacement of activity from St. Maarten to Trinidad. The pattern of the transhipments, however, changed over time. While the quantities transhipped have fluctuated annually, shipments were reported throughout the 1990s and are continuing into the 2000s.

Longline fishermen from Japan, Korea, Taiwan, and Panama (flag-of-convenience vessels), Venezuela, and other countries used St. Maarten as a transhipment point. Most of the transhipments have come from Taiwan longliners, but only a few have actually had Taiwan flags. A smaller number of nationalities were involved by the late 1980s, reportedly Korea, Taiwan, and Panama.[141] The authors have noted declining Korean activity, but some Venezuelan activity. The one constant has been that most of the activity is usually Taiwan-owned longliners.

Japan: Japanese longliners during the 1970s and early 80s are believed to have transhipped through St. Maarten. The Japanese, however, shifted to a transhipment at sea procedure and no longer need shore-based transhipment points. ICCAT officials reported in 1993 that the level of transhipments have declined significantly at St. Maarten in recent years. ICCAT reports that the Asian countries which had been using the facilities at St. Maarten are transhipping more of their catch at sea to freezer cargo vessels.[142] This certainly was the case for the Japanese, but the decline in 1993 may have reflected a shift in Taiwan fishing strategy because over a decade earlier had stopped using St. Maarten.

Korea: The authors have little information on Korean transhipments through St. Maarten. One report indicated that such transhipments occurred in 1979.[143] As Korean Atlantic longlining declined in the late

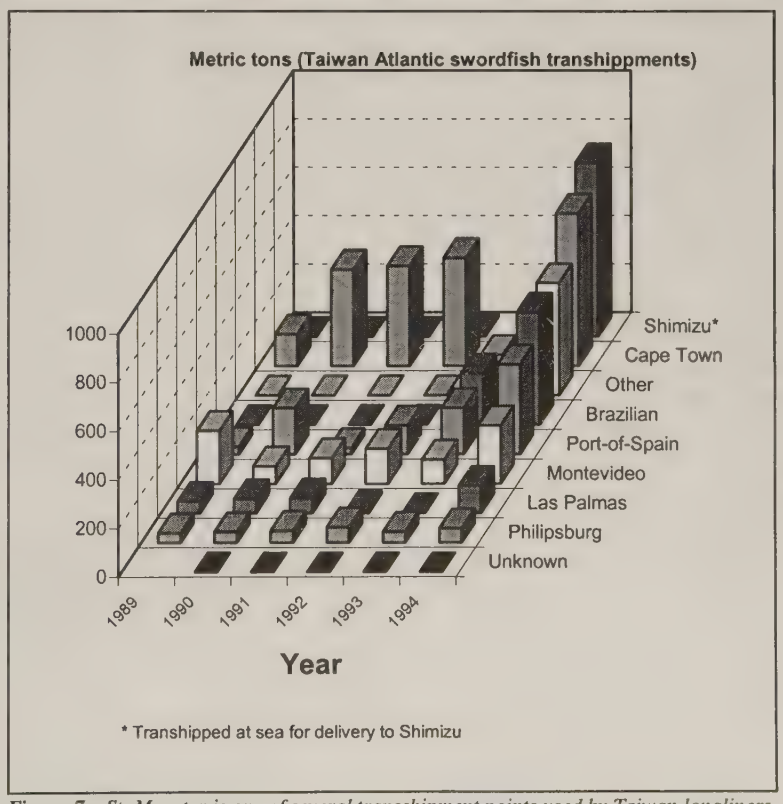

Figure 7.--St. Maarten is one of several transshipment points used by Taiwan longliners. Data through 1994 indicated that it was one of their smaller operations.

Photo 17.--Taiwan longliners operating out of Orangestad on Aruba during 1986-87 delivered their catch to this refrigerated cargo vessel. Alfredo Pichardo

1980s and is now conducted south of the Caribbean, no Korean transhipping is thought to occur at St. Maarten.

Taiwan: Most of the activity during the 1990s appears to be Taiwan longliners unloading frozen product. The Taiwan fleet has periodically shifted their fishing strategy thus affecting transhipments through St. Maarten. The Taiwan fleet in the late 1980s was targeting albacore seasonally off both Turks and Caicos and Bermuda.[144] This catch was transhipped at St. Maarten to Puerto Rican canneries, but very little swordfish was shipped to the United States. The Taiwan fleet shifting in 1990 to bigeye at tropical latitudes. Transhipments to the United States plummeted from $12.1 million in 1989 to only $0.1 million in 1990. The bigeye then being caught is believed to have been mostly shipped to Japan. Swordfish shipments to the United States continue to be nil or negligible until 1995. Taiwan fishermen in that year resumed shipments to the United States. once again it was primarily albacore. The billfish bycatch, which cannot be shipped to the United States, is mostly being marketed on other Caribbean islands.[145] The authors do not have time-line data on the number of Taiwan longliners involved in this operation. Scattered anecdotal reports have mentioned about 20 large Taiwan longliners. A report from the St. Maarten Port Authority listed 24 Taiwan longliners in 2000 (appendix A3). Many of the vessels are Taiwan owned, but have flag-of-convenience registrations. Some reports indicate that the Taiwan vessels are older longliners in a poor state of maintenance. Some appear, however, to be relatively new vessels.[146]

Panama: The authors have no information on Panamanian flag-of-convenience transhipments other than that some have occurred. Panama maintains one of the largest flag-of-convenience registries.

Venezuela: One Venezuelan report indicates that the Venezuelan company Pesquera de la Isla, based in Puerto la Cruz, sometimes targets albacore outside the Antillean Arc. The company operates the Chimana vessels (appendix A3). These trips are sometimes 3-4 months in length. Shorter trips are usually within the Caribbean.[147]

European Union (EU) sanitary officials visited the Nichirei Carib in 1999 to explain the new EU sanitary rules. At the time Nichirei was exporting tuna to Germany. Nichirei representatives were concerned about the cost of modernizing the facility to meet EU guidelines.

Few published details exist about the Nichirei facility. Company officials declined to provide information for this report. Various observers have visited the Nichirei facility. One observer reported that premises seemed "quite old and derelict". Another observer described the freezers as "huge," although the precise size is unavailable. More than one observer

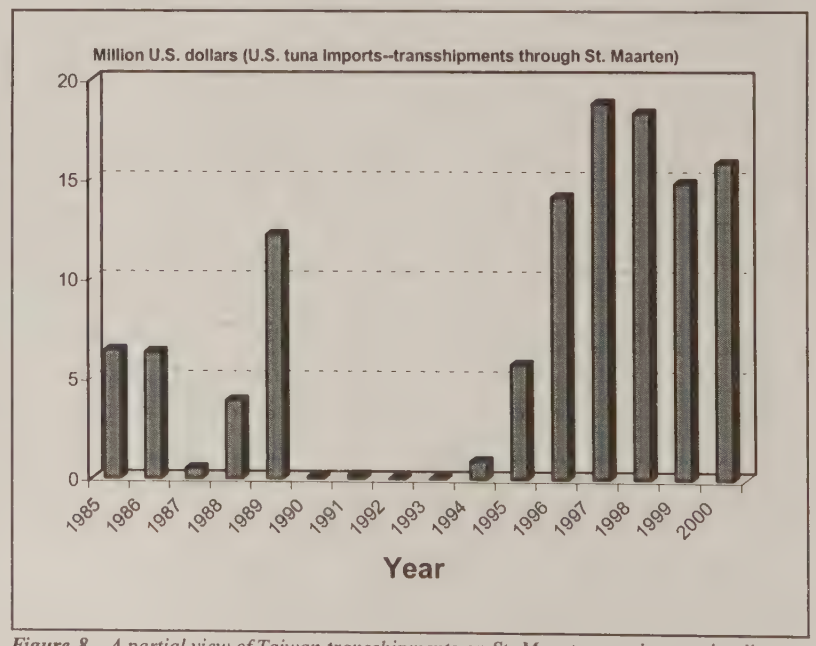

Figure 8.--A partial view of Taiwan transshipments on St. Maarten can be seen in albacore shipments to the United States. The level of transshipments to Japan and Caribbean sales are unknown.

commented on the large quantity of billfish observed, but no actual data is available on the quantities involved.

Many on St. Maarten are reportedly unhappy about the Nichirei operation. The company has been criticized for not employing locals. Nevertheless, the company does contribute to the local economy. The longliners bunker locally. After a long time at sea, in some cases 6 months, the crews are known to be big spenders in St, Maarten nightlife. For these reasons the company also has some political influence.

B. Activity

Precise data is not available on transhipping activities through the Netherlands Antilles. Available data, however, suggests that substantial quantities of tuna, swordfish, and billfish are being transhipped through St. Maarten. The authors know of no data released by the companies involved or by Antillian authorities. Some data is available from Taiwan. The great bulk of the product transhipped was through St. Maarten by Taiwan fishermen and the major species involved was tuna. Most of the tuna was shipped to Japan or the United States. Only limited data is available on the quantities shipped to Japan, however, detailed information is available on the shipments to the United States. Comparisons with data available from the Taiwan transhipment point at Port of Spain, Trinidad also offer some insights.

Antilles: The authors are unsure if Antillian officials have any transhipment data. The authors have only two reports from the Japanese companies chartering the Taiwan longliners (Curaçao Pioneering/Nichirei Carib) which provide very different assessments.[148] Curaçao Pioneering representatives in 1988 indicated that Taiwan longliners were transhipped about 24 boatloads of tuna and other species annually. The annual total reported was about 6,000 t, consisting of approximately 5,520 t of tuna (mostly albacore) and 60-80 t of billfish.[149] Nichirei reported the catch composition of the Taiwan longliners in 1991. Swordfish was 11 percent of the catch and tuna was 35 percent. Surprisingly marlin was nearly 30 percent (Bermuda, appendix B7).[150]

Japan: The Japanese accurately report the flag-of-origin of vessel that caught the fish rather than the port-of-origin as is the common practice of U.S. Customs. This means St. Maarten transhipping data can not be deduced from the Japanese import statistics.

Taiwan: Taiwan for several years published data on the level of transhipments trough foreign ports around the world. Taiwan officials reported that St. Maarten was one of their smaller transhipment points They reported that 40-64 t of swordfish from 1990 to 1994 was transhipped through St. Maarten annually (appendix C1). Much larger quantities of tuna would have been transhipped as swordfish was only a bycatch. Taiwan authorities stopped reporting on transhipments in 1994.

Trinidad: Some data from Trinidad differs with the available Taiwan data. Available data from Trinidad (appendix C2a) provides lower estimates of swordfish and other species being transhipped than the Taiwan transhipment data (appendix C1). The Trinidad data suggests that the transhipments through St. Maarten could be quite low. An assessment of the 1993 data suggests very small quantities, perhaps 540 t of fish, including only 13 t of swordfish (appendix C2b).

United States: Little swordfish is being transhipped to the United States through the Netherlands Antilles. The Taiwan landings in St. Maarten are frozen. The strongest demand in the United States is for fresh swordfish, but frozen product is also imported. It is unclear why the frozen swordfish being taken by the Taiwan longliners is not being transhipped to the United States through St. Maarten. It may well be that certain species are transhipped at sea. We know, for example, that Taiwan longliners by 1994 were shipping very large quantities of swordfish directly to Shimizu in Japan (appendix C1). The level of Taiwan transhipping activity can in part be measured by looking at tuna shipments to the United States from the Netherlands Antilles. Virtually all such frozen shipments would come from St. Maarten. Taiwan sharply reduced albacore tuna transhipments to the United States through St. Maarten in 1990. Shipments declined to very low levels during 1990-94 (appendix D2b1). Taiwan swordfish transhipment data, however, shows that swordfish transhipments continued with little change during this period (appendix C1). The Taiwan fleet in 1990 shifted its emphasis from albacore to bigeye which was then directed at Japan rather than the United States. Significant albacore shipments were resumed to the United States in 1995 (appendix C2). Since 1996, tuna shipments through St. Maarten ranged from 5,700 t (1996) to 8,000 t (1998). Actual landings of all species on St. Maarten could be substantially greater.[151] Swordfish alone could be about 600 t based on the quantity of albacore shipped to the United States. Some reports suggest that much greater quantities of swordfish may be involved (appendix C4a).[152] Billfish transhipments could be even more significant. Available data suggest that billfish transhipments through St. Maarten are very substantial. Estimates range widely, but could exceed 15,000 t (appendix C4b). It is not possible to know precisely what quantity of billfish is being transhipped through St. Maarten unless the data is released by the company involved. It does appear, however, that the quantity probably exceeds the billfish catch of all the Caribbean

island countries combined. It should also be noted that the level of transhipments through St. Maarten is only a fraction of the level shipped through the Taiwan facilities at Port-of-Spain, Trinidad. This would mean that overall Taiwan billfish transhipments in the wider-Caribbean are much larger than the quantity being transhipped through St. Maarten.

X. Processing and Products

The authors know of no swordfish processing in the Netherlands Antilles. The one company handling swordfish, Blue Caribbean Seafood on Curaçao, has a small processing plant. Some of the tuna catch is processed into fillets and portions. The Marriot Hotel on Curaçao, for examples, has requested very specific portions. Much of the small swordfish catch is shipped as unprocessed fresh trunks. Blue Caribbean also processes snappers and groupers taken by the local fishermen.[153]

XI. Companies

A. Companies

The authors have only limited information on Netherlands Antilles companies involved in fisheries, in part because there are very few such companies. There appears to be only two important companies involved with oceanic pelagics. One is apparently a subsidiary of a Spanish company with little real involvement in the local fishing industry.[154] The other company, Blue Caribbean Seafood, is a N.A. company which is launching a small tuna longline fishery.

Albacora: This company has arranged for the registration of Spanish purseseiners under the Antillian flag. The vessels are deployed in the Atlantic and do not land any fish in the Netherlands Antilles. This has proven controversial within the Antillian Government. The authors are unsure when the vessels were first registered, but they are known to have been operating at least by 1999. They continued to operate in 2001. The authors are unsure about the relationship between Albacora and the Overseas Tuna Company.

Antillian Sea Food: The U.S. Consulate General reported in 1988 that the only known seafood company in the Netherlands Antilles was Antillian Sea Food which operated a seafood processing and packing plant.[155]

Blue Caribbean Seafood: Blue Caribbean is a new company located in Willemstad on Curaçao. The owners are Cor Gouw and Arie Zuurmond. Blue Caribbean is both a fishing and processing company preparing frozen fish and fillets. They have a cooling chamber, cold store and run a processing line capable of filleting and making portions. It is the most active fish processing company in the Netherlands Antilles during 2001. They purchased the catch of the 12-m Driekiel in 1999 and have also purchasing fish from *Raven*. They began actual longline operations in February 2001 with the *Bigeye*, a Louisiana-built steel hulled longliner.[156] It is deployed in the deepwater to the north of Curaçao. They have hired a experienced Canadian captain, although he is new to longlining. The company is also interested in contacting U.S. captains that have worked in the southern Caribbean.[157] Their captain uses lightsticks and generally fishes at depths of 60-100 meters. They target tuna, both yellowfin and bigeye. Swordfish is taken, but mostly as a bycatch. They also report billfish (mostly sailfish), oilfish, mako shark, and dorado in the bycatch. With their new longliner they have reported five shipments in early 2001.[158] They also reported export shipments in 1999 and 2000 from export operations. The company put the *Bigeye* in drydock for a few weeks in June-July 2001 for servicing.[159] Blue Caribbean is the only Antillian company known to have obtained an exemption from the FDA automatic swordfish detention rule (Caribbean Overview, appendix F2d2). About 50-60 percent of the catch is normally exported. The rest is sold locally to tourist hotels and restaurants and supermarkets.[160] Blue Caribbean plans to build a new processing plant at Caracasbaai. One of the features of the proposed plant is a large ice-making plant that can produce both slush and flake ice. The company is planning a plant with a large enough capacity to supply both its needs as well as the needs of artisanal fishermen. Currently many artisanal fishermen use only limited quantities of ice because the price is high and availability limited.

Bonaire project: A company (name unavailable) was formed by the central N.A. government and Bonaire government to manage the Bonaire Koel en Vrieshuisproject fisheries development project in the late 1970s. It began by building a small freezing plant and ordering three boats at the Antillean small craft yard.[161] The project involved 11 steel and fiberglass hull vessels ranging from 8-10 m with trolling gear and hydraulic snapper reels. The boats were leased to fishermen with options to buy them.[162]

Curaçao International: This company was the registered owner of the *Astrid*, a vessel reportedly involved in illegal whaling. Some reports suggest it

may have been the *Yasjmi Maru* with a new name.[163] The vessel was registered in the N.A. by SINA. Other N.A. agencies point to *Astrid* as an example of international complications that can result from licensing poorly regulated foreign fishing vessels.

Curaçao Pioneering: A 1981 report indicated that a Japanese firm on St. Maarten, Curaçao Pioneering, was exporting king mackerel, small tunas, and marlins at relatively low prices. This appears to be the bycatch of the Taiwan longliners transhipping their catch at St. Maarten. The primary income generator is the tuna being landed, thus the company is willing to accept quite low prices for the bycatch. These species could be sold for attractive prices on Curaçao, but the limited availability of freight vessels limits such sales.[164] The company's name has been changed to the Nichirei Carib Corporation.

Diaz: Angelo Diaz owns and operates the 15-m *Make My Day*. The vessel has been equipped with longline gear, but it is only occasionally engaged in actual fishing trips. Trips that are conducted are usually within 10 km of Curaçao. Unconfirmed reports in 2001 indicate that it has not proven successful, in part because the crew has little longline experience, but there are also problems with the boat.

Fondelgroup: The Dutch company Fondelgroup operated the 12-m *Driekiel*. They worked with Blue Caribbean which bought much of the catch. The *Driekiel* did not prove suitable for longlining oceanic pelagics from Curaçao. The trials conducted in 1999 showed that a larger vessel was needed for pelagic longlining in the often rough waters north of the island.

Nichirei Carib: Nichirei Carib is the St. Maarten subsidiary of the Japanese food conglomerate Nichirei. It is the transhipment facility formerly known as Curaçao Pioneering. The company in 2000 had leasing arrangements with 24 Taiwan longliners (appendix A3). It was one of the smaller transhipment points for the Japanese Atlantic longline fleet (appendix C1). The Taiwan vessels operating with Nichirei Carib have been transhipping large quantities of tuna, mostly albacore to the United States (appendix D2b3). Data on swordfish and billfish transhipments are not available, but are potentially significant (appendix C4a-b). Shipments to Japan, however, are unknown (appendix C3). There appears to have been shipments to Europe, but EU data since 1995 has shown either nil or minimal shipments (appendix D3). One N.A. officials reports, however, that there have been recent shipments to Europe especially Germany.[165] One observer official visiting the company in 1999 reported that many facilities look run down. Company officials in meetings with EU officials during 1999 expressed concern with the cost of modernizing the facilities to meet revised EU import regulations. While the company has had no trouble with albacore shipments to Puerto Rico, there have been some problems with the quality standards for frozen bigeye and yellowfin (appendix D2c). Shore based sampling of the billfish bycatch to obtain size frequency data is carried out by ICCAT researchers.[166] The company appears to have an arrangement with Sang's Super Market for local sales.

Overseas Tuna Company: The Overseas Tuna Company is based in Spain, but has a branch office at Willemstad, Curaçao. The company is owned primarily by Spanish interests. The Curaçao office was opened in 1996 and handles banking, sales, export, and registry of the vessels. The company in 1999 operated eight large tuna Spanish-built purse seiners (about 75 m in length), all of which are registered in the Netherlands Antilles. The vessels carry crews of 23-30 persons. They target yellowfin and other tunas in the Atlantic and Indian Oceans. The company complies with European Union regulations governing, sanitation, customs, crew safety, and other matters.[167] The catch is mostly sold to companies in Kenya and Spain. The Overseas Tuna Company has expressed an interest in working with local fishermen, but has not yet been able to get the necessary government authorizations.[168] Some government officials do not take this offer seriously, considering it to be a marketing gimmick to promote N.A. membership in ICCAT.

Red Mullet Fishing Company: This Curaçao company was the registered owner of the fishing vessel *Tonna* which was reportedly involved in whaling operations during the 1970s. Company representatives declined to provide information on their operations when contacted by the U.S. Consulate General.[169]

Vispaleis: Vispaleis (Fish Palace) on Curaçao is owned by Cor Gouw who has also started Blue Caribbean Seafood with Arie Zuurmond. It is one of the major locations where fresh fish can be purchased in the island. European fish is imported for the local market.

Zrover: This is the principal retail outlet offering locally caught fresh fish on Aruba. Unlike Curaçao, there is no central market.

Unknown company: Another company or individual operates the *Raven*. It has been used for longlining, but in April 2001 was undergoing repairs. The owner is considering reentering the longline fishery.

B. Cooperatives

An importer of boats and cars in 1977 reported organizing a cooperative on Curaçao. They were focusing on the tuna fishery and offered services to foreign tuna vessels. They also planned to purchase a longliner for operations off the Netherlands Antilles.[170] The authors know of no such actual purchases by any cooperative.

XII. Markets

A. Domestic

There is a strong demand for seafood in the N.A. which has grown in recent years with the expansion of the tourist industry. Most of the catch is sold without processing almost immediately after it is landed. Fish has to be imported to meet the local demand.

Aruba: A variety of demersal as well as pelagic fish are available on Aruba. Much of the fish is supplied by Venezuelan fishermen who bring in fish once a week. There is no central market. The largest fish monger offering fresh fish is Zrover. Frozen fish, largely imported, is available in the supermarkets.[171] Much of the fish commonly served in restaurants, except for snapper, is imported product.[172]

Curaçao: The largest fisheries market in Curaçao used to be the Central Market. When opened in the late 1970s, the Market had an ice making unit which could produce 14 t per 24 hours and a 50 cubic meter cold store capable of holding fish at 0°C. Fish was sold on ice from fiberglass covered benches.[173] Local officials in 1985 reported that about 50 t annually moved through this market.[174] A 2001 report indicated that the facilities at the Central Market are no longer functioning. They have been privatized and run as a quasi-autonomous foundation, the Fundashon Marshé (Market Foundation) by FS employees. Small quantities of locally caught fish, as well as fish bought from Venezuela fishermen, are sold. The retailers have to bring their ice from the Caracasbaai fishing port. Caracasbaai has become the main selling point for the domestic fishermen, although some Venezuelan fish is also sold there.[175] The Vispaleis is another important retail outlet, but for largely imported product. Local fishermen do not fully supply the domestic demand, necessitating imports. The Vispaleis offers fish imported from Europe. Fish can also be purchased at the Venezuelan floating market which has operated for years. One report described the Venezuelan floating market in the early 1960s, but it apparently began even earlier.[176] It is still in operation.[177]

St. Maarten: Seafood on St. Maarten can be purchased in fresh fish markets. There are two on the Dutch side and two on the French side of the island. The Dutch markets are located at Simpson Bay and Great Bay (Philipsburg). The larger, government subsidized market is located at Simpson Bay. The species commonly available at these markets include snappers (silk, yellow-tail, red, dog, and vermillion), groupers, queen triggerfish, and hinds (red and rock). Occasionally there are other species such as jacks, scads, surgeonfish, doctorfish, and goatfish. An occasional billfish also may also appear. Only locally caught fish is sold in these markets. There is no imported fish or fish being landed by the foreign longliners at the Nicherei transhipment facility. Local fishermen also have informal sales points. Fishermen who have a good catch may sell some of it from the back of their pick-up trucks. There are no specific sites involved and the they tend to move about the island. Supermarkets offer a selection of seafood, but this tends to be already processed, imported product. The supermarkets do handle imported swordfish and dorado (mahi-mahi). Small quantities of the foreign catch landed at Nichirei does appear in the supermarkets.[178]

Photo 18.--Fishermen market snappers, groupers, angelfish, parrotfish, goatfish, and other species. This fish was taken by fishermen setting traps on the Anguilla Bank. Weidner

The authors have little information on the local Netherlands Antilles markets for swordfish. As it is not a species traditionally taken by domestic fishermen, it is not a species with which most Antillians are familiar. Swordfish is, however, popular with tourists and a

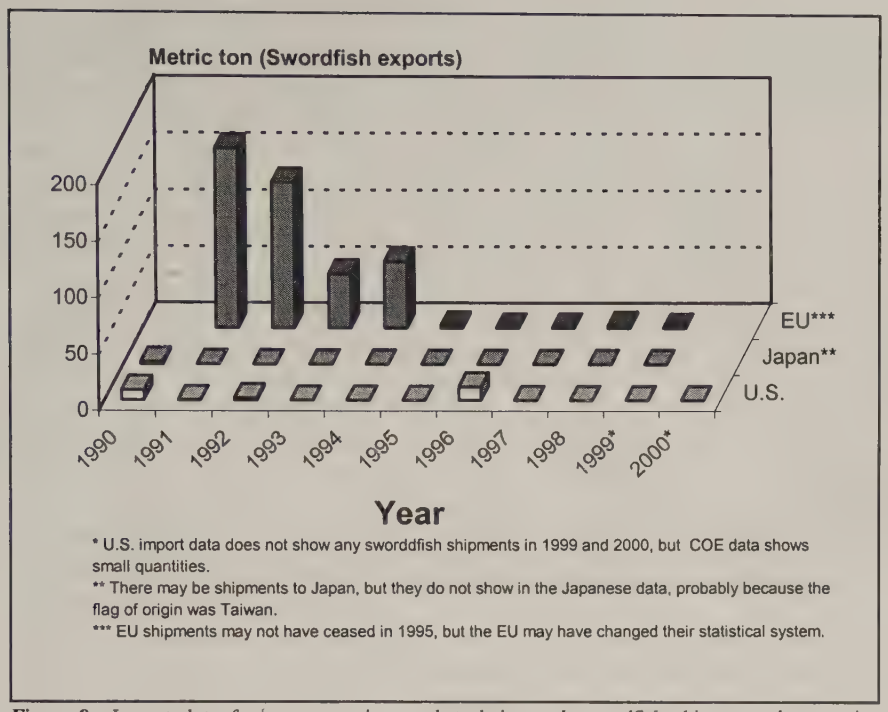

Figure 9.--Import data from some major markets help track swordfish shipments, but varying treatment of data means that many shipments do not appear as imports.

substantial part of the demand for seafood on the Dutch islands comes from tourists.

The traditional troll fishermen do take many other pelagic species, such as wahoos, small tunas, dorado, king mackerel and even some billfish. Officials estimate that billfish constituted about 5 percent of the total catch. Reports from Curaçao indicate that billfish is sold locally.[179] Billfish is a species commonly marketed in the Caribbean, but rarely appears in Aruban markets.[180] Shark is another species that is rarely seen in Antillian markets and there appears to be little demand for shark.[181] This may be due to overfishing of inshore stocks. One Curaçao researcher believes that nearshore stocks have been serious overfished. He made some inshore fleet estimates in 1995 and concluded, "these figures add up to a minimum of 38,078 user half-days per year directed at harvest along the 65-km long south coast (only during daytime hours and excluding both the north coast and the inland bays)." This included all gear types.[182] Under such circumstances, the chance that any top predator will swallow a hook and perish before maturity is enormous.[183]

B. Trade

Major seafood consuming countries have imported substantial quantities of swordfish from the Netherlands Antilles. The authors believe that virtually all of this swordfish is transhipments from foreign longline fishermen, rather than swordfish caught by domestic fishermen. Most of the frozen product is probably transhipped through facilities on St. Maarten. Some fresh product may have been transhipped through Curaçao. There have also been shipments through Aruba.

1. Exports

All three major importing countries (European Union, Japan, and the United States) have reported swordfish imports from the Netherlands Antilles. Available data does not indicate from which islands the swordfish is shipped, but it is believed to be primarily St. Maarten--especially the frozen product. Most of the swordfish has been shipped to the European Union. The shipments from the N.A. have declined sharply during the 1990s. Shipments have fallen from nearly 160 t in 1991 to only 2 t in 1995 (appendix D1). There have also been occasional shipments to the United States, probably also transhipments. Some limited exports were reported in 1999 an 2000 from actual Netherlands Antilles longliners (appendix B3c). A company initiating full-scale longline operations in 2001 is reporting 2001 shipments.

European Union: Substantial shipments of swordfish were reported to the EU during the early 1990s. Nearly 160 t were shipped to the EU during 1991, most of it frozen product shipped to Germany and Spain. These shipments have gradually declined and totaled only 2 t, all shipped to Germany in 1995 (appendix D3). The product was transhipped Taiwan-caught fish and not actual imports from Antillian fishermen.. Some reports indicate that shipments to Europe, especially to Germany, were still taking place in the late 1990s. The virtual cessation of N.A. shipments to N.A. may represent a statistical change rather than an actual change in shipping patterns as suggested by the data.[184]

Japan: Japanese import data suggests that only limited quantities of billfish were shipped to Japan during the 1990s (7 t in 1990), which may have been about 2 t of swordfish. Much larger quantities of billfish were shipped during the 1980s, over 350 t in 1986 which may have accounted for over 100 t of swordfish (appendix D4). The absence of 1990s shipments,

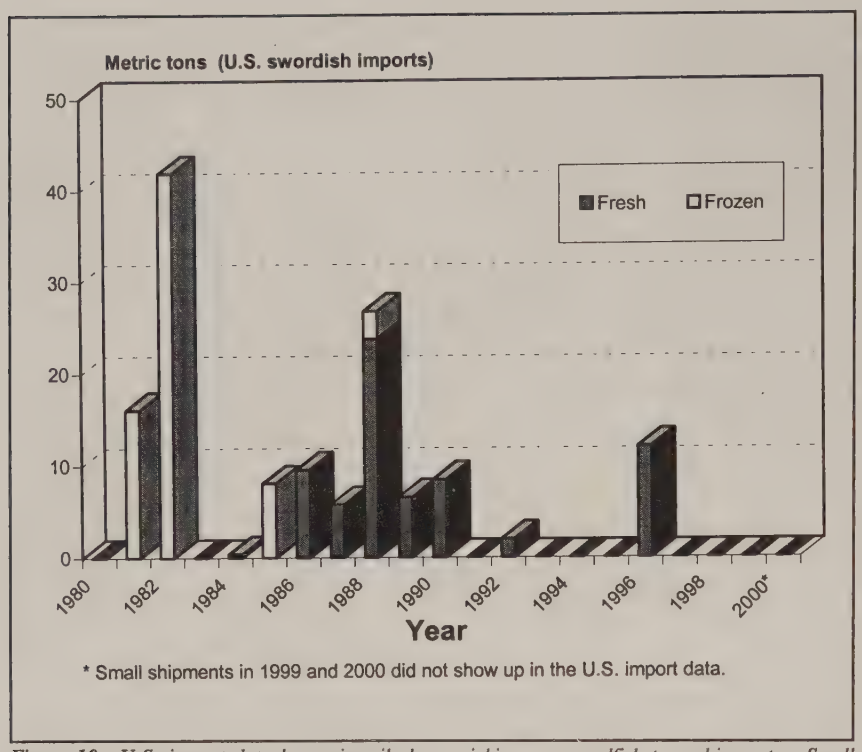

Figure 10.--U.S. import data has primarily been picking up swordfish transshipments. Small shipments in 1999 and 2000, however, which were actual imports from the NA, did not appear in the U.S. data.

however, may simply mean that Japanese authorities are classifying them as shipments from Taiwan or flag-of-convenience country rather than Antillian shipments because the fish were caught by fishing vessels registered in those countries.

United States: Transhipments of Taiwan-caught fish are routinely misidentified as Antillian product in U.S. import data. Reported swordfish shipments to the United States have been limited during the 1990s, only 8 t in 1992 and 12 t in 1996 (appendix D1). Shipments during the 1980s, however, were much more substantial, as much as 42 t in 1982 (appendix D2a1a). Most of the shipments to the United States through 1985 were frozen product. All of these shipments appear to have been transhipments.[185] This was probably swordfish transhipped by Taiwan longliners. Since 1986 the product has been mostly fresh, probably product transhipped by other foreign or even U.S. longliners. Since 1999, Curaçao-based Blue Caribbean Seafood has begun shipments to the United States. While the shipments have not yet shown up in the U.S. import data, with the initiation of full-scale fishing operations in 2001, their product should begin to register in the U.S. data.

The Netherlands Antilles exports relatively small quantities of fish taken by local fishermen. There have, however, at times been substantial imports noted from the Netherlands Antilles--especially tuna shipments. In many cases these shipments are really transhipments or imports in which Antillian domestic fishermen have actually had little or no role. This is true of virtually all of the frozen tuna which may appear in various data bases as imports from the Netherlands Antilles. The statistical problem is further complicated by the flag-of-convenience fishing vessels registered by SINA.

Gann fleet: Substantial quantities of tuna were exported during the 1970s and early 80s. The tuna was not caught, however by domestic Antillian fishermen, but rather U.S.-owned purseseiners flagged in the N.A.. These seiners were primarily deployed in the Eastern Pacific (appendix A2b) and owned by the U.S. fisherman Edward Gann. N.A. officials report that the U.S. State Department at the time expressed great concern about these vessels.[186]

Tuna/dolphin problem: Problems with the United States developed during the 1980s and were associated with efforts to protect dolphins incidentally killed in purseseines during tuna fishing operations. The N.A. at times has had an embargo placed by the United States on its shipments of yellowfin tuna. The trade action was a "secondary" embargo as a result of importing tuna from Venezuela and Colombia. These two countries were, at the time, shipping tuna that had been caught by vessels not meeting U.S. dolphin protection standards.[187] The quantities of tuna were minor, but to avoid the U.S. embargo, the N.A. would have had to pass a law prohibiting tuna imports from those countries. This was politically impossible in the N.A.[188] The embargo was eventually lifted as a result of litigation in the United States. The N.A. Government, along with France, appealed the embargo to the World Trade Organization and the case is still pending.

St. Maarten transhipments: Substantial tuna shipments through St. Maarten are recorded by the United States as imports from the Netherlands Antilles. These shipments are actually transhipments by foreign fishing vessels, especially Taiwan longliners.[189] This is discussed above in "IX. Transhipments".

Spanish purseseiners: As the Spanish purseseiners are currently registered in the N.A., their catch would legally be a N.A. export, even though the vessels do

not land the catch in the N.A. or fish in N.A. waters. The authors, however, have no information on the disposition of the catch. It is unclear at this time if the substantial quantities of tuna taken and exported by the Overseas Tuna Company are counted as either Netherlands Antilles exports or whether importing countries ascribe the country of origin to Spain because of the ownership of the vessels. The international convention is to use the flag of the vessel. Countries vary, however, as to how they follow the general rule. Spain for example may treat the catch as part of its domestic catch. As the vessels are purseseiners, swordfish catches would be minimal.[190]

Other: There have been a variety of other tuna shipments noted for brief intervals. Both Taiwan and U.S. longliners, for example, transhipped tuna, swordfish, and other species through Aruba for a few years in the 1980s.

Domestic shipments: Small shipments of fresh tuna and swordfish have been reported by the N.A. beginning in 1999. This is fish actually caught by Antillian fishermen and shipped by local companies.

2. Imports

The Dutch Caribbean islands (especially Aruba and Curaçao) import seafood to supply the domestic market. The domestic fishery can not supply the local demand for seafood in either quantity or diversity of species required. FAO data indicates that the Netherlands Antilles has substantially reduced seafood imports during the 1990s, from $9.5 million in 1990 to only about $3.5 million in 1998. Aruba, on the other hand, has significantly increased imports from $5.2 million in 1990 to $17.6 million in 1998 (Caribbean Overview, appendix F1). The increased level of Aruban imports was first reported in 1996.

Data from Curaçao, the most populace Dutch island, shows that over half of all seafood imports are fresh, chilled and frozen fish and cured fish used in several traditional Dutch dishes. Conch and shrimp are of some importance as well as canned fish. Seafood imports were 5-9 percent of total food imports during 1990-95, but were declining in importance.[191]

Seafood is imported from the United States and other countries. Venezuela is an especially important supplier.[192] The authors have no current data on these shipments, but they appear to be largely demersal fish, shrimp, and a variety of other species. As the domestic Antillian fishery in the Leeward Group is primarily pelagic, there is a great demand for the demersal species taken by the Venezuelans. Much of these imports are informal with direct sales by Venezuelan fishermen landing their catch in Aruba and Curaçao. Swordfish is a species targeted by Venezuelan longline fishermen. Swordfish are not believed to be involved in the Venezuelan trade.

Except for the Venezuelan trade, imported seafood is mostly sold in supermarkets and a few dealers such as the Vispaleis on Curaçao. Much of the imported product is frozen, although cured imports are of some significance.

The authors know of no swordfish imports as the species is little known to Antillean consumers. It has never been supplied by the artisanal fishermen. Small quantities may be imported by tourist hotels and restaurants. Billfish is available on Curaçao.

XIII. Government Policy

The Netherlands Antilles government structure is somewhat complicated. The status of Aruba is a further complication.

Netherlands Antilles: At the Netherlands Antilles Central Government level, the agency responsible for fisheries is the Department of Economic Affairs (DEPEZ). At the island level, such as Curaçao, which has the N.A.'s largest fishing fleet and industry, the fisheries agency is the Fisheries Section (FS) in the Department of Agriculture, Animal Husbandry and Fisheries. The Central Government has jurisdiction in the N.A. EFZ. Local fisheries are generally administered by each separate island government. Each island in the N.A. has a fisheries office. The responsibilities of the N.A. central government and individual island authorities are not always clear cut and overlap to some degree.

Aruba: Aruba in particular, before separating in 1986, was insistent on having its own fishery regulations. While separated from the Netherlands Antilles (N.A.), the fisheries agency on Aruba is organized identically to the Netherlands Antilles. The Aruban fisheries agency is the Fisheries Section in Department of Agriculture, Animal Husbandry and Fisheries

A. Fisheries law and regulations

The Netherlands Antilles has issued some regulations on longlining. Fishermen can not use marine mammals for bait. All vessels larger than 12 m or 6 GRT need a permit. No permits are given to foreign longline fishermen.[193]

Curaçao officials have assessed the controversy over longline fishing, especially the potential for bycatch and impact on local artisanal fishermen. They have tentatively concluded that the bycatch does not appear to be a major problem. They also believe a commercial longline fishery will not compete with the local fishery. This is in part because the local fishermen stay close to the coast and the longliners operate in offshore waters. Also because the longliners target highly migratory oceanic pelagics they are unlikely to fish out an inshore stock and thus impact artisanal operations. The conclusion drawn by Curaçao officials is that longliners, perhaps deploying a combination of gear, are needed to develop the pelagic fisheries north of Curaçao and Bonaire. "To prevent longlining would mean turning the EFZ into a tuna and swordfish reservation that would only help maintain the catch of foreign distant-water fishermen." Officials go on to say, "Without longlining, developing a local fishery in the EFZ would be impossible."[194]

Some of the most effectively enforced fisheries regulations are those pertaining to coral reefs. Regulations prohibit spear fishing and the removal of both living and dead coral from underwater parks.[195] These regulations are effectively enforced by local officials and the dive operators.

B. Licenses

The Netherlands Antilles has a system of divided responsibilities for licensing fishermen. Small boats and those boats operating within territorial waters (12 miles) are the responsibility of individual island authorities. Larger boats and those operating outside the territorial sea are licensed by the N.A. central government. Virtually all foreign vessels would need a license from the N.A. central government which can issue 12-month permits.[196]

The N.A. central government has issued a few licenses to Venezuelan fishermen. The N.A. has, however, not issued licenses to foreign fishermen who have not conducted historic fisheries.

Spain: No permits have been granted to Spanish fishing vessels, even the ones with Antillian flags, because they have not fished historically in the area.

United States: The authors know of no licenses issued to U.S. longliners. Antillian authorities have decided to reserve longline licenses to domestic fishermen.

Venezuela: The N.A. has issued some licenses to Venezuelan baitboats and smaller seiners of the "Flota del Caribe". Unlike the larger Venezuelan seiners, these vessels operated in the Caribbean and adjacent Atlantic. Since these fishermen had historically fished around Antillean waters and would have suffered if excluded, a few licenses were issued allowing operations within the Curaçao and Aruba EFZ as long as they stayed at least 12 miles offshore. Permits for swordfish longliners were not granted because they had not operated historically. Permits for the larger seiners were refused because they have alternate fishing grounds available.[197]

C. Limits

The Netherlands established a 12-mile Territorial Sea in 1985.[198] The same act provided for archipelagic strait baselines off the Netherlands and a subsequent Royal Decree established the baselines for Aruba and the Netherlands Antilles.[199] The Netherlands enacted a 200-mile fishing zone in 1977.[200] The N.A. in 1978 negotiated a treaty with Venezuela delimiting their common marine border. The N.A. conceded areas north of the island to the Venezuelans that they could have claimed, in part so as not to close off western Venezuela from a Caribbean projection. In exchange, the Venezuelans conceded a larger area of the shelf near Aruba than they had planned to offer.[201] The Netherlands signed the Law of the Sea (LOS) Convention in 1982 and ratified it with a declaration in 1996.[202] The N.A. Government and Aruba established a fisheries "boundary" between the Curaçao and Aruba in 1993.[203] A maritime boundary between the N.A. and Aruba was not finalized until 1995.[204] Agreement with affected states concerning the N.A. and Aruba boundary was achieved in 1998. The N.A. Government also declared a 200-mile Exclusive Fishing Zone (EFZ) in 1993.[205] The declaration of the EFZ was delayed because of the need to reconcile the constitutional powers of the individual island governments regarding fisheries with that of the international responsibilities of the N.A. Central Government. This issue was finally resolved with the N.A. Central Government Fisheries Law (Visserijlandsverordening), making extended jurisdiction possible.[206]

D. Promotion

Both the N.A. and Aruba are heavily dependent on imported food stuffs. Officials are interested in expanding the small artisanal fishery to expand domestic food production. The central and local governments have sponsored a variety of development projects, including some projects involving longlining. N.A. Central Government officials noted in 1975 that Cuban and Venezuelan publications described tuna as being present in the waters north of the Leeward Group and that the FAO research cruises aboard *Calamar* had detected large quantities of white marlin. They believed that a combination longliner/troller could be

effectively deployed.[207]

A variety of fishery development efforts were initiated in the late 1970s continuing into the 1990s. The Government's fishery development strategy has been to fund small demonstration projects to serve as the nucleus for further development.[208]

Windward Group: Officials also believed that longliner/troller operations in the Windward Group could effectively target available tuna stocks.[209] St. Eustatius officials, however, focused largely on demersal resources. They initiated a project in 1990 for taking demersal species on Saba Bank. The project included a freezing plant and cold store.[210]

Bonaire Project: Bonaire imported nine 9-m fiberglass boats and two steel vessels in 1979.[211] The project was administered by a company the N.A. Central Government and the Bonaire government setup. Interestingly, officials report that some of the traditional methods used by the fishermen proved superior to innovations introduced by the project, intensifying skepticism on the part of the fishermen toward new technology.[212]

Curaçao Project: One 1978 report described plans to build 10 9-m vessels for trolling and a 16-m "mini-longliner" to be used for experimental and test fishing.[213]

The N.A. Government approached WECAF and other international donors for assistance. WECAF prepared detailed project plans.[214] One of the priority interests was ways of improving trolling operations and the introduction of longlines.[215] Officials believed that fisheries for pelagics could be expanded.[216] Officials in 1985 reported a Dutch-funded fisheries development project using a 14 m vessel to test pelagic longlines and driftnets. They also planned to deploy FADs.[217] Further work on FADs was conducted during the 1990s.[218] The N.A. Government in 1985 also conducted a fisheries development project for Saba Bank. Two 12-m vessels were being used and shore facilities were built on St. Eustatius.

The N.A. central government and private interests created the Development Bank of the Netherlands Antilles (Ontwikkelingsbank van de Nederlandse Antillen--OBNA) in 1981. The OBNA supports economic projects that further economic development. An OBNA press release in 1998 indicated that fisheries was one of the priority areas that they seek to promote.[219]

E. Management

Some NA observers are critical of the NA Governments fisheries management policies. A recent review article concluded that current marine resource management legislation in the Netherlands Antilles and Aruba remains highly deficient and fragmentary and identifies poor governance as the key problem in achieving sound fisheries resource management.[220] Another report, however, indicates that public environmental awareness and support for basic modern fisheries resource management are high.[221] One example of this is a agriculture and fisheries conference held in Curaçao in which fishermen voiced a strong preference for protective measures to prevent overfishing. Several fishermen spoke out stressing the need for conservation measures.[222] This was notable because in many countries fishermen often object to restrictions on fishing.

Some recent fishery management developments reported in the N.A. have included:

Aruba: Officials on Aruba have given priority to setting up a marine reserve and management area.[223]

Curaçao: Curaçao officials in 2001 report a new fisheries management plan (Visserijbeleidsplan). The plan approved by the Curaçao Executive Council on July 25, 2001.[224]

Other: Management on St. Maarten and St. Eustatius has been limited, in part because of funding. Officials and N.A. NGOs in 2000 warned that without additional funding, nature conservation management on St. Maarten and St. Eustatius "will cease to exist." They also indicated that nature conservation management on the other islands was "sub-optimal due to structurally insufficient financing."[225]

XIV. Research

The Netherlands Antilles Government has a limited research capability. There is a marine research institute located on Curaçao and they and some other research institutes have conducted some fisheries work. Most of that work, however, has focused on coral reefs and species such as the parrot fish associated with the reefs.[226] This is in large part because of the importance of the reefs to the important tourist industry, which has replaced petroleum refining as the N.A.'s major source of income. Very little research has been conducted on pelagic species, despite the fact that much of the fisheries catch is composed of pelagics.

Agriculture Service of Curaçao: The Curaçao Fisheries Section (FS) in the Agriculture, Animal Husbandry, and Fisheries Service of Curaçao has since 1993 been working on a project assessing fish aggregating devices (FADs) in tuna fisheries. The project has assessed both FAD effectiveness and the best method of constructing them.[227] The primary effort has been along the southern coast of Curaçao with the objective of increasing pelagic catch rates for troll fishermen.[228]

CARMABI Foundation: CARMABI is the only marine research institute of the Netherlands Antilles. The Caraibisch Marien-Biologisch Instituut (Caribbean Marine Biological Institution--CARMABI) was founded in 1955 to promote scientific research on marine species, especially those found off the N.A. CARMABI has been especially active in work on coral reefs which are important to the growing tourist industry. In the 1970s, the focus of the research program shifted towards coral reefs which allowed the organization to play a seminal role in the establishment of marine parks on Bonaire, Curaçao, and Saba. In the 1980s, the focus gradually shifted away from principally marine research toward a broader program of applied resource management in both aquatic and terrestrial habitats. The name of the institute was changed to the CARMABI Foundation.[229] Some work has been reported on marine environmental topics, such as sea grass areas on different islands.[230] CARMABI marine research in recent years has focused on exportable crustaceans, crabs, lobsters, marine contamination, algal productivity, sponge and coral population dynamics, the nursery function of seagrass beds, and various management related issues.[231] A current listing of CARMABI research publications is available on their website.[232] The authors know of no CARMABI research on large pelagic species.

Curaçao Sea Aquarium: The Curaçao Sea Aquarium was opened in 1984 and has proven to be a popular tourist attraction. It is situated at Curaçao's Underwater Park. The Sea Aquarium has an active educational and marine awareness program, but the authors have little information about ongoing research efforts or published studies by Aquarium staff. Sea Aquarium officials, however, have indicated that they are involved in research projects.[233] The Sea Aquarium is known to care for injured turtles brought in by fishermen.[234]

Photo 19.--The Curaçao Fisheries Section has been assessing fish aggregating devices, primarily off the island's southern coast. The primary focus has been the pelagic troll fishery. Gerard van Buurt

Government Experimental Station Santa Rosa: The Department of Agriculture in 1976 established the Santa Rosa Experimental Station. The station was set up to experiment with animal husbandry and agriculture in an effort to diversify the Aruban economy. It was also responsible for government fisheries research on Aruba, but the authors have no information on the fisheries research, if any, conducted there. The station has since become the central office of the Aruban Department of Agriculture, Animal Husbandry, and Fisheries. The offices of the Fisheries Section are located there. Aruban officials hope to

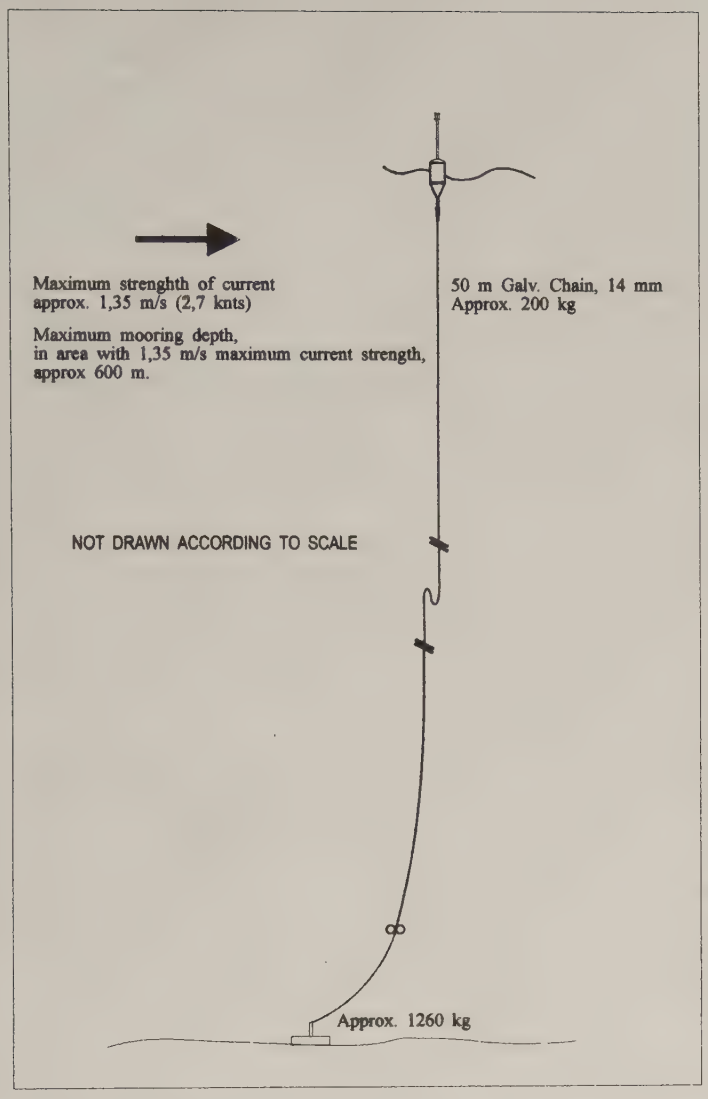

Figure 11.--This is the deepwater FAD mooring system used with the Curaçao Fisheries Service's MKII surface buoy. Van Buurt

establish an independent marine research institute that would manage marine reserves, coordinate research, and disseminate information to the public about marine reserves and fisheries.[235]

MARCULTURA: The MARCULTURA Foundation, as the name suggests, focuses on aquaculture research. It was founded in the 1970s. MARCULTURA has been especially active with conch, but has also worked on shrimp, tilapia, and other species.[236] MARCULTURA has since been privatized. Practically no documentation, however, was made of its culture travails. The facilities have been taken over by a Venezuelan company Sea-Hatch which also has facilities on Aruba. The company operates hatcheries exporting shrimp postlarvae to stock growout ponds. There is a small growout facility on Bonaire, primarily to supply broodstock. The MARACULTURA Foundation still exists. It has paid off its debts with the proceeds from the sale of its facilities and plans to invest the remaining funds to participate in the Curaçao FAD program as well as extend it to Bonaire and Aruba.[237]

STINAPA: The National Park Foundation of Bonaire (STINAPA) has sponsored some fisheries work. Much of the marine research, however, has focused on marine ecology and problems associated with coral reefs and marine parks.[238] It is sometimes referred to as Karpata.[239]

University of the Netherlands Antilles: The University is primarily an academic institution with a limited research program. The University is focused primarily on law, social sciences, economics, and engineering. There is no known marine biology program.

Various foreign groups have conducted some work on oceanic pelagics.

Florida Institute of Technology (FIT): The FIT has assisted in the preparation of fisheries development plans, including plans for exploratory fishing vessels, gear and tuna operations.[240]

ICCAT: ICCAT has used port samplers to sample billfish. Initially problems arose because fish unloaded were dressed, complicating species identification and standardized length measurements. ICCAT developed protocols to assist with species identification and conversion of data on dressed carcasses to live-weight equivalents.[241] ICCAT researchers, however, have reported continuing problems sampling the transhipments through St. Maarten.[242]

IFREMER: The Institute Francaise de Recherche pour l'Exploitation de Mer (IFREMER) has been active in Caribbean marine studies, primarily around the two French islands of Guadeloupe and Martinique. IFREMER research among many other subjects has addressed longlining and FADs. IFREMER has not been active in the Netherlands Antilles, but has been interested in FAD work done off Curaçao.[243] They plan to work with Curaçao researchers to refine the effort calculating drag on FADs.[244]

NMFS/NOAA: The National Marine Fisheries Service (NMFS) reports that resource assessment cruises using *R/V Oregon II* were conducted in 1970. Cruise 22 assessed benthic shrimp resources off Colombia, Venezuela, Curaçao, and other areas and set longline gear to assess swordfish distribution.[245] NMFS also reports some tuna tagging done in cooperation with N.A. officials aboard the *R/V Rhonda Sue*.

University of Amsterdam: Researchers at the University of Amsterdam have done a wide variety of marine studies in Curaçao and the Netherlands Antilles. UA researches have also worked on sea turtles in the

Caribbean, but not specifically on turtles in the Netherlands Antilles. The research has been on general population trends and a variety of biological subjects.[246] The authors know of no work on fishery interactions with turtles.

University of the West Indies: Researchers from the University of the West Indies (Cave Hill Campus, Barbados) collected flyingfish samples for genetic assessments as part of a Caribbean resource assessment of that species.[247]

The authors have noted references to various groups in connection with research in Curaçao.

Curaçao Pioneering Company: This Japanese company on St. Maarten sampled billfish being offloaded by Taiwan and other foreign longliners during the 1980s. The sampling was part of the ICCAT research program. Some problems with data were experienced as most of the fish offloaded were trunks, making it difficult to accurately access live weight and length.[248] ICCAT also noted concern with the level of sampling.[249] As a result, ICCAT terminated its contract with the company. The company's name has since been changed to the Nichirei Carib Corporation. One N.A. researcher reports that this company played a short and minor role in research under the auspices of ICCAT and yielded few if any usable research results.[250]

Nichirei Carib Corp.: The Nichirei Carib Corporation (NCC) with ICCAT technical assistance has conduted billfish sampling for ICCAT. ICCAT specialists reported sampling about 700 billfish held in the NCC transhipment facility during the third quarter of 1993.[251] ICCAT after the cancellation of its contract with CPC, arranged for the Nichirei Carib Company (NCC) to collect data on off-loaded billfish carcasses by distant-water longliners in St. Maarten. (See: "Transhipments.") NCC is conducting shore-based sampling of size frequency.[252] Continued sampling was reported in 2000.[253]

Soviet Union: Quite a number of Soviet research vessels were present around the Netherlands Antilles during the 1980s. N.A. officials reported in 1981 that Soviet research vessels were increasingly using the port of Willemstad on Curaçao. N.A. authorities reportedly asked Dutch officials to request that the Soviets restrict port visits.[254] Other reports indicate that Soviet vessels calling at Willemstad were restricted to visits of only 2 days.[255] One local observer reports that he is not sure what the Soviet vessels were doing or that the Soviet authorities intended to do any relevant research.[256]

XV. Bycatch

Antillian fishermen have not reported a longline bycatch because there has been no longline fishery. There has, however, been some take of species generally associated with the longline bycatch.

Antillian artisanal fishermen: Antillian fishermen using troll gear, however, have targeted many of the species taken as bycatch by longliners--with the exception of swordfish.

Foreign longliners: There also has been a substantial, but largely unquantified bycatch reported by the Taiwan and other foreign longliners operating out St. Maarten. Virtually none of this bycatch was taken in Antillian waters and most was taken outside the Caribbean basin. The quantities of bycatch associated with the operations out of St. Maarten, however, may be substantial. Many of the species are highly migratory with ranges that extend into the Caribbean. Thus catches outside the Caribbean often affect the abundance of these species within the Caribbean basin.

Antillian longliners: The introduction of tuna/swordfish longliners in 1999 means that Antillian fishermen will now also be reporting a longline bycatch species, albeit given the small effort, in only limited quantities. The Curaçao Fisheries Plan notes the possible bycatch problems associated with longlining.[257]

A. Tuna

1. Antillian fishermen

The current Antillian tuna catch is limited, but may increase with the acquisition of longliners.

Artisanal fishermen: Antillian fishermen using troll gear have reported modest tuna catches. About 240 t was reported in 1998. The principal species landed was yellowfin, but blackfin and skipjack were also reported. Catches as high as 280 t have been reported (appendix B2a1).

Longline fishermen: The longline fishermen who began operating in 1999 may substantially increase the Antillian tuna catch. The longline fishermen are targeting tuna with swordfish taken mostly as a bycatch.[258] Results to date have been limited. Part of the tuna catch is exported fresh, but only minor shipments of fresh product were reported in 1999 and 2000 (appendix D2b3). The Blue Caribbean seafood longline operation using *Bigeye* in 2001 reports taking both bigeye and yellowfin.[259]

2. Foreign fishermen

There has been a substantial, but unknown tuna catch reported by the Taiwan and other foreign longliners operating out St. Maarten. Most of these fishermen targeted tuna. The great bulk of the catch was taken outside the Caribbean basin. Just based on shipments to the United States during the 1990s, nearly 8,000 t of tuna, mostly albacore, was transhipped in one year. Data on transhipments to Japan are unavailable (appendix C3). Available data, however, suggests that the tuna shipments to Japan by the St. Maarten based longliners probably exceed the quantity of albacore shipped to the United States, although there are substantial annual variations.[260] Actual transhipments to Japan physically moving through St. Maarten may actually be limited. The vessels operating from St. Maarten may make substantial transhipments at sea.

The Netherlands Antilles has since 1999 licensed eight Spanish tuna purseseiners (appendix A2a). These vessels are not deployed to fish in Antillian waters or land the catch at Antillian ports. In fact, they have nothing to do with the Antillian fishing industry except that the vessels are registered in the Netherlands Antilles. Antillians officials reported a tuna catch of 24,100 t in 1999.[261] Presumably this is the catch of the Spanish seiners because the quantity of tuna reported dwarfs the Antillian domestic catch of all species combined (appendix B1a).

B. Billfish

1. Antillean fishermen

Antillian recreational and artisanal troll fishermen take billfish. Due to the increasing trend of tag and release fishing, much of the recreational catch is returned. Less is known about the Antillian billfish catch than virtually anywhere else in the Atlantic.[262] Only rough estimates exist for Antillian billfish catches.

Aruba: Most of the billfish taken off Aruba is sailfish. Virtually all the billfish taken on the shelf to the west and south of Aruba is sailfish. Marlins can be taken to the north and east in deeper water.[263] ICCAT estimates suggest that fishermen take about 10 t of sailfish (appendix B4b3). FAO reports the Aruban sailfish catch is negligible. While no blue marlin is reported, recreational fishermen on Aruba do mention taking blue marlin.[264] It is thus also likely that some of the troll fishermen take the species. Recreational fishermen report that white marlin have been taken in the past, but are now rarely seen.[265]

Netherlands Antilles: Antillian fishermen primarily take marlin. The blue marlin catch in 1996 was

estimated at 40 t (appendix B4b3). Although not reported by ICCAT and FAO, there is also a substantial white marlin catch. While the sport fishermen primarily take blue marlin, the artisanal fishermen may take more white marlin.[266] Smaller catches of sailfish are also reported, about 15 tons. No breakdown by island is available, but much of this catch would have been taken by Curaçao and Bonaire fishermen in the Leeward Group. One official notes that Curaçao fishermen reported that about 5 percent of their troll catch was billfish.[267] Trollers take fish at or near the surface. Such a substantial catch suggests that off Curaçao billfish occur higher up in the water column than is usual. He speculates that this may explain why longline fishermen operating near the island who set their hooks at greater depths, achieve relatively modest billfish catches.[268]

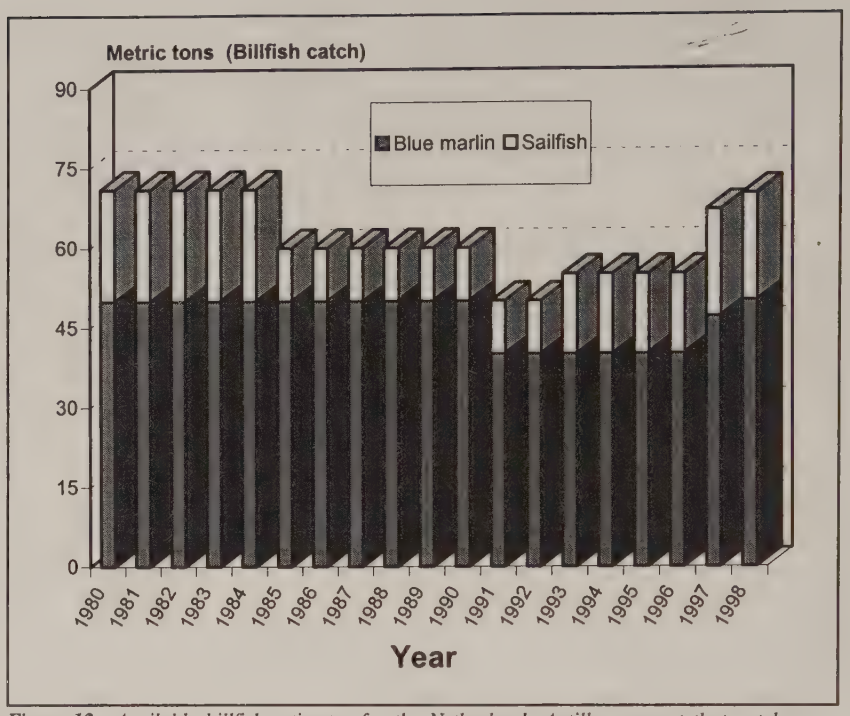

Figure 12.--Available billfish estimates for the Netherlands Antilles suggest that catches are mostly blue marlin and have been declining for an extended period.

Some recreational fishermen have expressed concern about billfish bycatches and the potential impact on sports fishing. Sports fishermen are concerned about both foreign and domestic longliners.[269] A sports fisherman/environmentalist on Aruba is disturbed about the quantities of billfish reportedly taken by Venezuelan longliners.[270] He reports some frustration as to what he describes as the lack of concern on Aruba and other Dutch islands with marine conservation issues. Of all the Dutch islands he believes only Bonaire has a strong environmental movement. He does not understand why there is not more interest. Tourism is the main industry in the Dutch Caribbean and a healthy marine environment attracting sport fishermen and divers is critical to the industry's success. He is especially concerned about the impact of longlining on billfish stocks.[271]

Government officials indicate that the longliners which Antillian fishermen have begun to deploy in 1999 are not reporting high billfish bycatches. Venezuelan longliners operating in the area have also been reporting low billfish bycatches. The billfish bycatches were much lower than the percentage of billfish being taken by the artisanal troll fishermen. These fishermen who operated during the day reported relatively high billfish bycatches. The bycatch of the domestic longliners is reportedly more sharks and rays.[272] Officials have noted concerns expressed by sport fishermen, but contribute them in part to "IGFA coaching".[273]

2. Foreign fishermen

The foreign longliners transhipping through St. Maarten land billfish. This billfish catch is a bycatch of the tuna fishery pursued by the Taiwan fishermen, but of some commercial interest to the fishermen. Some of the catch is transhipped, mostly to Japan. Some is marketed in Antillian and other Caribbean markets. The authors know of no actual data on the level of billfish transhipments through St. Maarten. The company involved does not release any data. Such shipments could be substantial. There are, however, quite a range of estimates, varying from extremely low levels to quite substantial quantities. While actual shipments may prove to have been less than the higher range of estimates, the authors believe that very substantial quantities of billfish are being transhipped. In all likelihood, the transhipments through St. Maarten may exceed the billfish catch of all the Caribbean Island countries combined.

Curaçao Pioneering/Nichirei Carib: Nichirei Carib officials have declined to provide information to the authors as to the quantity of product transhipped or the species composition. Nichirei and the predecessor company Curaçao Pioneering have provided varying estimates on bycatch levels to other analysts. The estimates provided vary substantially. Catch trends can indeed fluctuate from year to year, especially if

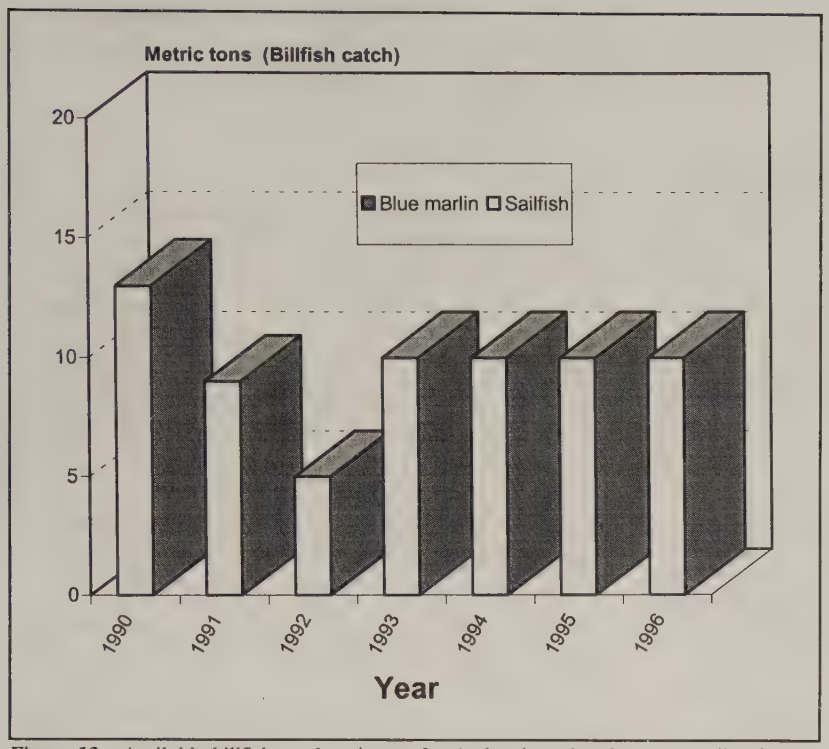

Figure 13.--Available billfish catch estimates for Aruba show that they are smaller than for the Netherlands Antilles and virtually all sailfish.

different fishing strategies are employed and grounds shift. The two available estimates are very different. Curaçao Pioneering representatives spoke with an NMFS official in 1988. They indicated that the Taiwan longliners which they were chartering transhipped about 24 boatloads of tuna and other species annually. An average boatload was about 250 t which included about 2.5 t of billfish (2 t of white marlin and 0.5 t of blue marlin). The annual total reported was about 6,000 t, consisting of approximately 5,520 t of tuna (mostly albacore) and 60-80 t of billfish. The albacore was mostly transhipped through St. Maarten to Puerto Rico and the billfish to other foreign markets.[274] This billfish bycatch estimate seems quite low, only about 1 percent. The authors are unsure how to treat it. There are several factors which potentially complicate the use of the data. There are no observers to corroborate the data. It probably does not include billfish hooked, but not brought aboard. The 60-80 t of billfish may also just be the billfish transhipped to Japan and not fish sold in local Caribbean markets. Nichirei Carib representatives in the early 1990s spoke with British consultants and provided data on the catch composition of the Taiwan longliners in 1991. Swordfish was 11 percent of the catch and tuna was 35 percent. Surprisingly marlin was nearly 30 percent (Bermuda, appendix B7).[275] Billfish bycatches at this level would of course mean very substantial overall billfish bycathes.

Trinidad data: St. Maarten shipments could be extrapolated from Taiwan landings in Trinidad which would suggest modest billfish transhipments of about 80 t in 1993 (appendix C2b).[276] The authors believe, however, that actual Trinidad billfish transhipments have been much larger. Actual annual transhipments would vary with the number of longliners contracted and the target species and grounds.

U.S. albacore imports: Estimates computed by the authors based on tuna shipments suggests that several thousand tons of billfish are being transhipped through St. Maarten. One estimate suggests that over 15,000 t of billfish may have been transhipped (appendix C4b). While these rough projections may prove high, they do suggest that very large quantities of billfish may be involved in the Taiwan fleet operations out of St. Maarten.

C. Sharks

1. Artisanal fishermen

The authors have noted various comments concerning sharks. FAO test longline fishing off Bonaire did not find sharks.[277] Some sport fishermen, however, note sharks as one of the species that they target. A Government official reports that much of the Antillian longline bycatch reported in initial operations is composed of sharks and some rays.[278] Neither the N.A. or Aruba lists shark separately as one the species which they provide data to FAO (appendices B2a-b). As a result, little is known about actual Antillian shark landings. Antillian officials and researchers report that artisanal fishermen currently take very limited quantities of shark.[279] There appears to be no market for shark on Curaçao, but this appears to be largely do to intense overfishing of inshore grounds.[280] The same appears to be the case on the other Dutch islands.

2. Foreign fishermen

Venezuelan fishermen conduct a directed shark fishery and there has been some Venezuelan shark fishing in Antillian waters. One Aruban environmentalist reports that Venezuelan fishermen in the 1980s were using lines to take sharks in coastal waters. In some cases this was occurring near hotels and beaches. He reports that he discouraged the

and beaches. He reports that he discouraged the Venezuelans from continuing this practice and has not noted it in recent years.[281]

Substantial quantities of shark are believed to be taken annually in the Atlantic by the Taiwan longliners transhipping through St. Maarten. Little of this shark is taken in Antillian waters. The quantities of shark caught by Taiwan longliners are largely unknown, but could be substantial. Very little actual data is available. Some estimates can be run using the limited available data which provide an idea of the possible order of magnitude of the sharks taken by the Taiwan longliners operating from St. Maarten.

Trinidad data: Transhipment data from Trinidad suggests that Taiwan vessels may have transhipped about 80 t of shark through St. Maarten in 1993 (appendix C2b). Based on this estimate, actual shark catches including the live weight of the sharks which were finned could perhaps exceeding 1,700 tons (appendix C5a).[282]

Taiwan transhipment data: The authors note that higher estimates exist for transhipments through St. Maarten (appendix C1). These higher estimates would suggest that the Taiwan longliners in St. Maarten could be catching much larger quantities of shark, over 5,000 tons (appendix C5a).

U.S. import data: Some idea of the scale of Taiwan operations can be obtained by assessing U.S. albacore imports. Most of the Taiwan albacore catch of the St. Maarten-based vessels is shipped to the United States. While the lack of Taiwan reporting on their shark bycatch makes it difficult to accurately assess the possible shark catches associated with the albacore shipments, clearly substantial quantities of shark are involved. Even if the higher end projection is discarded, the level of albacore shipments to the United States suggests shark bycatches of about 20,000 t (appendix C5b).

At sea discards: The above estimates, large as some are, may well be an understatement of the actual quantity. We do not know, for example, just what quantity of shark Taiwan fishermen are discarding at sea. We do know that such discards do occur. Standard Taiwan practice, similar to other longline operations, is that if the catch is particularly good, the crew will focus on the most valuable species and sharks may be cut off the line without actually bringing them aboard.[283] The authors are unable to quantify this practice. A factor which affect the impact on shark stocks of the longline bycatch is that large numbers of sharks which are hooked, but discarded without finning apparently survive. Obviously the finned sharks die. However, many sharks that are cut off the leader line and not brought aboard for finning are alive.[284] Quite a number of these, especially the blue sharks, are known to survive. NMFS has several tagging reports of blue sharks with more than one longline hook still embedded.[285]

F. Other finfish

The authors know of no detailed study at this time on catch composition indicating other species of fin fish taken in the bycatch. One company reported taking oilfish. A N.A. longline fisherman reported taking a sting ray which was not retained. Dorado are a species commonly taken in the bycatch. Some observers reported an interest in short sidelines being added to longline sets to take dorado. While it has not been adopted by N.A. longliners, some Venezuelan longliners are reportedly using it.[286]

E. Turtles

Four species of sea turtles are reported found around the various Dutch islands in both the Windward and Leeward Groups. The four commonly reported species are leatherbacks (*Dermochelys coriacea*), greens (*Chelonia mydas*), hawksbills (*Eretmochelys imbricata*), and loggerhead (*Caretta caretta*).[287] Other species are occasionally reported.

Turtles are protected under a N.A. central government ordinance as well as various island ordinances.[288] Enforcement of the regulations, however, is often limited, especially on the smaller islands. One observer on St. Maarten reports, for example, that turtles are only rarely taken by the artisanal fishermen and officials do not strictly enforce the central government regulations. Violations are not prosecuted.[289] Authorities on Curaçao, however, have prosecuted fishermen who land turtles. The most recent was the crew of the longliner *Make my Day* which was prosecuted in February 2001 for landing a leatherback. Officials report that the unintentional take of a turtle as bycatch is not a violation of the law. The retention of a turtle, even taken unintentionally with the purpose of selling it, is against the law. It is not clear if the leatherback taken by the *Make My Day* could have been released alive, but the crew had butchered it with the clear intention of selling the meat.[290]

Available details concerning sea turtles on the individual islands includes:

Aruba: Archeological evidence shows that sea turtles were utilized by pre-Colombian people. The northwest of the island has sea grass beds which attract turtles. Since the review by Barmes and his colleagues, leatherbacks are now known to nest regularly on island.[291] Hawksbills, greens, and loggerheads are seen in the waters off the island. One nesting site is

Conchi di Tortuga (turtle bowl) near Daimari along the northern coast.

Bonaire: Bonaire is surrounded by important coral formations and sea grass beds which provide forage for juvenile greens and hawksbills.[292] One report indicates that turtles were particularly common at the entrance to Lagoen, a lagoon along the eastern coast. The turtles were mostly grazing on sea grass.[293] There are also small nesting populations of hawksbills and loggerheads.[294] A detailed assessment of Bonaire turtles was prepared in 1995.[295] Local environmentalists reported in 1996 that former turtle fishermen continued to take small numbers of turtles illegally and that plans existed to develop Klein Bonaire, a small uninhabited island off the western coast where most of the nesting activity occurs.[296] Researchers in 2001 report that the fishermen continue to take small numbers of turtles. The Government has, however, purchased Klein Bonaire from private owners and has set it aside solely for conservation.[297]

Curaçao: The most common sea turtles reported off Curaçao are reportedly greens and hawksbills, perhaps because they are more common in coastal waters where they can be more easily observed. Loggerheads and leatherbacks are not seen as commonly. A local fishermen in 1991 took an olive Ridley on a baited hook. This is the first report of an olive Ridley off Curaçao. The fisherman would have released the turtle, but its carapace was damaged in the rough waters along the northern coast and it was donated to the Curaçao Sea Aquarium.[298] A detailed assessment of Curaçao turtles was prepared in 1995.[299] Nesting by hawksbills, greens, and loggerheads are common.[300] A 10-km stretch of the north coast of the island referred to as "Shete Boka," encompassing a major portion of the sea turtle nesting habitat, was subsequently designated as a conservation area for protecting sea turtle nests.[301]

Saba: Recreational divers on Saba reports seeing numerous sea turtles.[302]

St. Eustatius: WIDECAST reports that sea turtles are known to nest on St. Eustatius and to forage in the fringing sea grass.[303]

St. Maarten: Recreational fishermen on St. Maarten report sea turtles.[304] A Sea Turtle Watch Group was organized in 1999 and they have noted some nesting by greens, hawksbills, and leatherbacks. They have observed 12 nesting episodes on the Dutch side of the island. Loggerheads forage offshore. Both reef and seagrass habitat exists for the turtles. Very limited interactions are reported with the small local artisanal fishery. Some of the local fishermen release turtles that they take incidentally, but enforcement of regulations is limited and sea turtle meat does occasionally appear in the local market.[305]

There is no data available on turtle interactions in Dutch Caribbean waters. The authors have noted a variety of reports with some pertinent information.

Antillian artisanal fishermen: Antillian fishermen do report seeing turtles. Some interactions result from trolling which accounts for the bulk of the N.A.'s fisheries catch. The extent of these interactions is unknown. These fishermen occasionally take turtles, but are usually able to release them alive.[306] The most serious interactions with sea turtles off Bonaire and Curaçao occur during seining operations targeting schools of bigeye scad (*Selar crumenopthalmus*) in shallow waters close to the coast. This fishery is especially common along the north coast of Curaçao and in Lac Bay on Bonaire. In recent years fishermen have reportedly been releasing these turtles. A number of turtles become entangled in the seines and drown before they can be released. The turtles in general are not now intentionally killed or harvested.[307]

Antillian longline fishermen: As described above longlining is just beginning, thus the longline fishermen have had only limited opportunity to encounter turtles. One leatherback turtle was hooked by the *Make My Day* and instead of releasing it as required, landed it in Curaçao where the captain was immediately prosecuted by N.A. authorities.[308] It was reportedly a

Photo 20.--Andy Caballero, a Marine Park Manager, with the Nature Foundation on St. Maarten is shown cleaning a green sea turtle that was rescued from a hardened tarspill.

leatherback, which one observer notes had rarely been hooked by the artisanal fishermen.[309] Another longline fisherman reported catching a turtle, probably a loggerhead, and releasing it--in part because of the experience of the other longline fisherman who was prosecuted for landing a turtle.[310]

Venezuelan longline fishermen: Curaçao officials report that bycatch data from the Venezuelan tuna longline fishery, which includes some operations close to Antillian waters, offers some possible insights into potential Antillean turtle bycatches. A study of longline operations from 1960-72 did not report turtle bycatches along with the bycatch of billfish , sharks, and other species.[311] The authors are hesitant to draw any firm conclusions from the Venezuelan study, especially as the minimal catch for reporting individual species was 0.1 percent. A turtle bycatch even below this amount could be potentially harmful for these endangered animals.

US longline fishermen: U.S. longline fishermen did not report turtle interactions in N.A. waters during 1998-99, but the effort is so limited that the data can not be used to draw any valid conclusions.[312]

E. Marine mammals

The authors have very limited information about marine mammals off the Dutch islands. Marine mammals are present off the Dutch islands. The authors do not have an inventory, but a variety of species are found.

Leeward group: Some recent work has provided information on cetaceans in the southern Caribbean. Marine mammals are present off the Dutch Leeward Group. A total of 13 species can be confirmed. The most commonly sighted whales are the Bryde's whale and the shortfin pilot whale The most commonly sighted dolphins are the spinner and bottlenose.[313] One report has even noted relatively uncommon species such as beaked whales and dwarf sperm whales.[314] The authors have noted no organized whale watching activity on the Leeward Group, but diving boat operators have reported sighting whales.[315] One Aruban sport fisherman reports observing Venezuelan fishermen operating off the Dutch Leeward Group during the late 1990s that were using dolphins for target practice with rifles.[316] The authors have no confirmation of these other than this report.

Windward group: Whales are also seen in the Windward Group.[317] Humpbacks moving from feeding grounds off Newfoundland have been noted on Saba Bank.[318]

The authors have little information about longline interactions with marine mammals off the Netherlands Antilles.

Antillean longlining: The lack of information on interactions with marine mammals off the N.A. has is in part because longlines have been so recently deployed. There has been until 2001 no serious longline fishing and as result there has been no bycatch. One longline fisherman in 2001, however, reports that he has experienced few marine mammal interactions during fishing operations. He reports several damaged carcasses when the line is retrieved, but believes it is due to sharks rather than cetaceans.[319]

Foreign longlining: There has been foreign longline activity around the islands. No information, however, is available on the interactions experienced by these vessels.

A variety of reports indicate that Netherlands Antilles-registered vessels were involved in whaling during the 1970s and early 80s. These appear to have been foreign-owned vessels not operating in the Caribbean, but few details are available.[320]

F. Seabirds

The Dutch Caribbean islands have some important seabird nesting rookeries. One study reported that 16 species of seabirds nest in the Dutch Antilles (appendix E). Aruba is an especially important nesting area.[321] A few studies exist on some seabird species, such as terns and gulls.[322]

The authors have no details on N.A. fishery interactions with seabirds. The authors know of no studies assessing seabird interactions with fisheries. Some fishermen report using seabirds, such as frigate birds, to spot fish.[323] Based on feeding behavior, one would not expect there to be significant tern interactions with fisheries, but gull interactions are possible.[324] Preliminary reports from some of the longliners (*Driekiel* and *Bigeye*) conducting trials and fishing operations north of Curaçao have indicated that longline sets have not resulted in seabird bycatches. The tendency to set at night may be one factor limiting potential seabird bycatches.[325]

XVI. International

A. International relations

1. Multilateral

The primary multi-lateral organization involved with fisheries which the Netherlands Antilles has shown an interest in is ICCAT.

CARICOM: Neither the Netherlands Antilles nor Aruba, like the French islands, participate in CARICOM. They thus have not been involved in CFRAMP or other CARICOM fishery activities.

IATTC: Neither the Netherlands nor the European Union (EU) is a member of the Inter-American Tropical Tuna Commission (IATTC). Since the N.A. registered tuna purseseiners were sold in the early 1980s, the N.A. has had no interest in IATTC. The European Union does participate as observers in some IATTC activities, especially the dolphin conservation program. Spain has applied for IATTC membership as five of its seiners were fishing in the Eastern Pacific during 1999 and 2000. These were not, however, the Spanish seiners registered in the N.A., but apparently vessels working out of Ecuador.

ICCAT: The Netherlands Antilles is associated with the Dutch Crown, but has internal self government. Neither the Netherlands or the N.A. is a member of ICCAT. The interests of the Netherlands and the N.A. are represented by the European Union. Unlike Britain and France, the Netherlands has not joined ICCAT to represent the interests of its Caribbean territories. ICCAT in 1995 adopted a resolution concerning an Action Plan to ensure the Effectiveness of the Conservation Program for Atlantic Swordfish. The Action Plan (AP) set forth a process to seek the cooperation of non-members with the ICCAT's Atlantic swordfish management plan. The AP encouraged interested parties to join ICCAT or at least voluntarily rectify fishing practices which diminish the effectiveness of ICCAT conservation measures. While ICCAT seeks voluntary compliance, as a last resort, non-discriminatory trade sanctions are possible. At its 2000 annual meeting, ICCAT noted that N.A. vessels were taking swordfish and not reporting that catch. The ICCAT Chairman wrote to N.A. officials in early 2001, urging cooperation with the management programs and to join the Commission. ICCAT plans to review the information regarding the N.A. at its 2001 annual meeting.[326] The N.A. has shown some interest in ICCAT membership.[327] At the 2000 ICCAT annual meeting, the N.A. observer indicated that his government was in the process of joining ICCAT.[328] It is unclear, however, to what extent he actually represented the views of the N.A. Government when he made that statement.[329] It is also not clear if the N.A. or the Netherlands would possible join for the N.A. as the EU allowed the UK and France to do for their Caribbean territories. N.A. officials also indicated that the N.A. was implementing a compliance requirement for its vessels "to support and comply with international legal instruments and conditions".[330] At this time the N.A. has not made a final decision on joining ICCAT. The debate over membership has proven quite contentious within the N.A. Government.[331] Officials are still assessing the need and possible benefits. There is not only the flag-of-convenience vessels to consider, but the small developing longline fishery being pursued by Blue Caribbean and other companies. Some officials believe strongly that it is not in the N.A.'s interest to join ICCAT. One Curaçao official, for example, believes, "The development of the resources of the EFZ is dependent on the the use of drift longlines and the

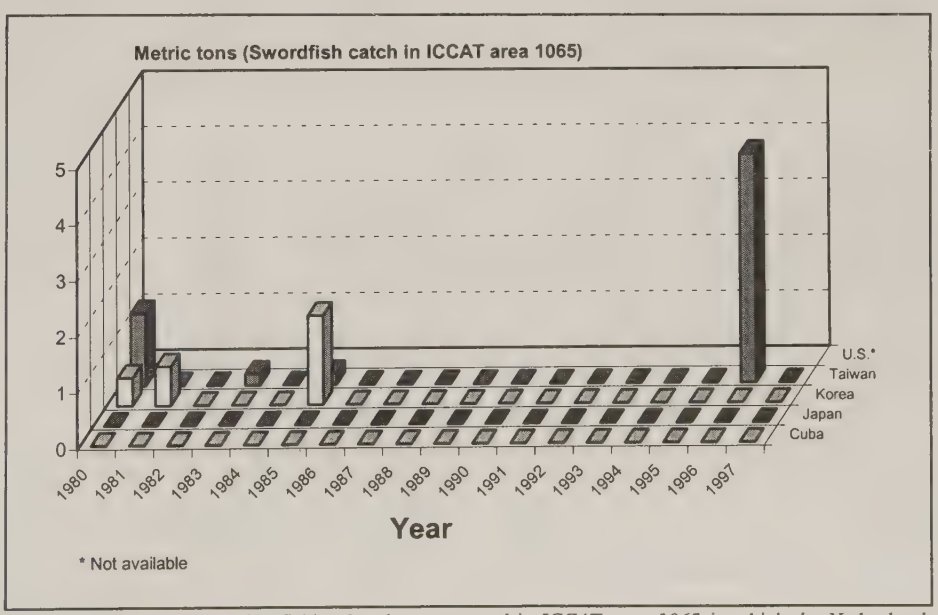

Figure 14.--Very little foreign fishing has been reported in ICCAT area 1065 in which the Netherlands Antilles Leeward island group is located.

longline fishery in the EFZ is dependant on swordfish. (It can probably not survive on tuna alone since catches are highly seasonal.) Membership in ICCAT would thus effectively shut down the longline fishery for tuna as well and with it any chance to develop the resources of the EFZ. This is the main sticking point. It would effectively screw up everything we have been working on for years."[332] There have been some ICCAT activities in the Netherlands Antilles, primarily collecting billfish data at the Nichirei Carib transhipment point and tournaments on St. Maarten.[333]

2. Bilateral

The ICCAT area immediately around the N.A. Leeward Group is 1065. The authors will address foreign fishing in this area here. We will also address foreign fishing in area 1070 immediately to the west off the coast of western Venezuela and Colombia. Foreign fishing in other adjacent ICCAT areas are discussed in other chapters of this report.

1060: ICCAT foreign fishing data for the southeastern Caribbean is discussed in the Grenada chapter of this report. There is also information in other individual island reports and the Venezuelan report.

1065: This is the ICCAT area that encompasses most of the Aruba and Netherlands Antilles Leeward Group (Bonaire and Curaçao) EFZs. ICCAT foreign catch data in this zone is discussed below.

1070: This ICCAT area to the west of Aruba is primarily encompassed by the Venezuelan and Colombian Exclusive Economic Zones (EEZs).[334] Foreign fishermen are more active in this area than immediately around the Leeward Group.

1560: This ICCAT area encompasses the EFZ of the N.A. Windward Group. ICCAT foreign catch data is discussed in the Anguilla chapter of this report.

1565: This ICCAT area is primarily encompassed by the Dominican Republic and U.S. EEZs. ICCAT foreign catch data is discussed in the Puerto Rican chapter of this report.

1570: This ICCAT area is located northwest of the N.A. Leeward group. It is primarily encompassed by the Haitian and Dominican EEZs. ICCAT foreign catch data is discussed in the Haitian chapter of this report.

The following information is available on foreign longlining operations around the Dutch Caribbean islands. As mentioned above, the foreign catch data here is that reported near the Leeward Group. For the ICCAT data around the Windward group see the Anguilla chapter of this report.

Colombia: One Aruban recreational charter operator reports that Taiwan longliners working out of Colombian ports have been targeting tuna and billfish north of Aruba, often as close as 15 km to the island. It is possible to hear their radio communications on Aruba. They also fish extensively off Punta Gallinas on Colombia's Guajira Peninsula--located due west from Aruba. The longliners appear to be fishing extensively off Puerto Estrella and other nearby Colombian ports.[335] Colombia has a very extensive program of licensing foreign fishing vessels. While many of the vessels are purseseiners or trawlers, there are also several longliners (Colombia, appendices A5a-A6d). Several Colombian companies work with Asian longliners. In the Caribbean the major companies in 1997 were Frigopesca, Océanos, and Pescadería Asturiana in Cartagena (Colombia, appendix A7).[336]

Cuba: Cuba acquired a commercial longline fleet in the 1960s. The fleet was, however, rarely deployed in the Caribbean basin. There has been no Cuban longlining around the Netherlands Antilles (appendices B5a-b).

Japan: The Japanese Curaçao Pioneering company based in St. Maarten has chartered foreign longliners. A 1979 report indicated that they were chartering Korean and Taiwan longliners for Atlantic tuna

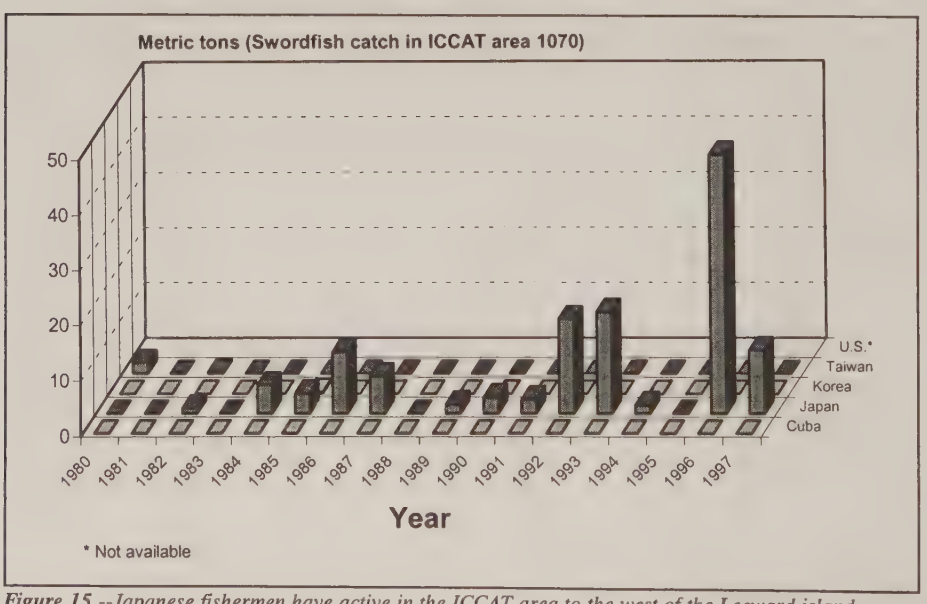

Figure 15.--Japanese fishermen have active in the ICCAT area to the west of the Leeward island group. This is probably the Japanese longliners working in association with Colombian companies.

operations.[337] Several of the vessels purchase Bermudian licenses for operations targeting albacore.[338] The vessels have also been deployed for bigeye in tropical waters. The company has changed ownership and is now Nichirei Carib. In recent years it has been primarily Taiwan longliners working from St. Maarten. Japanese fishermen have not been active in the northeastern Caribbean during the 1990s. They have reported no swordfish or billfish catches off the Netherlands Antilles, either around the Windward or Leeward group in recent years.[339] The Japanese were once quite active around the Leeward group, but have not fished there since 1977 (appendix B5a). In contrast, however, they have been very active west of Aruba. They have reported substantial catches there during the 1990s. In fact they reported a record 47 t swordfish catch in 1996 (appendix B5b). The Japanese operations west of Aruba show no discernable seasonal pattern. Four Japanese longliners are known to have been working with Colombian companies in 1997, but this may not have been a complete list (Colombia, appendix A7).

Korea: Korean longline fishermen operate in the Atlantic, but the effort deployed and the area covered is substantially reduced from the 1970s and early 80s. Some Korean longliners operating in the Atlantic regularly transhipped their catch at St. Maarten, at least in part because it operated as a free port. One 1979 report indicated that the Korean longliners were being chartered by a Japanese company.[340] The Koreans reportedly assured Dutch authorities that their fishing was conducted outside of the Netherlands Antilles 200-mile EFZ. Koreans officials report that seven longliners were operating out of St. Maarten in 1981.[341] Only minor activity has been reported around the Leeward group. The last Korean fishing around the Leeward group (ICCAT area 1065) and west of Aruba (ICCAT area 1070) was reported in 1985 (appendices B5a-b). While the Koreans only fished during a few years, they did report some notable catches. They took 19 t of swordfish around the Leeward group in 1978. There was no discernable pattern, but much of the catch was reported in the second half of the year.

(The) Netherlands: The authors in researching this report received a report of three longliners with Dutch crews in Willemstad during 2001. This report was erronious.[342] There have been no longliners with Dutch crews operating from the Netherlands Antilles. The first captain of the *Driekiel* was Dutch which may have given rise to rumors about Dutch crews. Almost surely this report referred to the N.A. longliners. The only known Dutch longliner is the *Seychelles* which Blue Caribbean reportedly tried to lease before purchasing the *Bigeye*.

Spain: Spanish fishermen have not deployed longliners in the Caribbean (appendices B5a-b).[343] Some Spanish tuna purse seiners in 2001 were operating under the N.A. flag, but they were deployed in the Atlantic and do not call at N.A. ports.[344]

Taiwan: Taiwan fishermen have extensively used the transhipment facilities at St. Maarten in the Windward group. Taiwan fishermen in the 1970s were chartered by the Japanese company on St. Maarten.[345] Although not a target area, the Taiwan longliners do make opportunistic sets in Caribbean waters while moving to and from the principal fishing grounds.[346] The Taiwan fishermen report less activity around the Leeward Group. While they reported some fishing in 1996 around the Dutch islands, this was the first fishing in ICCAT area 1065 since 1985 (appendix B5a). They have not fished in area 1070 west of Aruba since 1982 (appendix B5b). Almost all the Taiwan fishing was done during the second half of the year. While the Taiwan fishermen report only limited activity, some local observers report Taiwan longliners working in both Venezuelan and Colombian waters.[347] These vessels operate under a variety of charter arrangements and thus the catch may be reported as Venezuelan and Colombian rather than Taiwan catch.

United States: U.S. longline fishermen report some limited activity in the Caribbean basin, but rarely set in the waters around the Leeward Group. There is more activity south of Puerto Rico near the Windward group.

Venezuela: Venezuelan fishermen have in the past commonly operated illegally in Netherlands Antilles waters. There have been occasional seizures, but the N.A. Government seemed unable to strictly control the Venezuelan fishing. One report indicates that

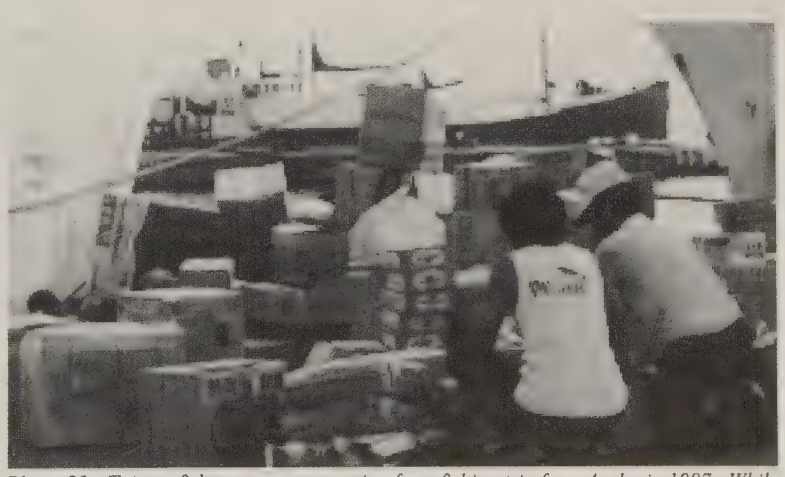

Photo 21.--Taiwan fishermen are preparing for a fishing trip from Aruba in 1987. While operations there were short-lived, Taiwan longline operations from St. Maarten have been conducted for years. A. Pichardo

Margarita Island fishermen were particularly active. Officials report that extensive Venezuelan fishing in N.A. waters has now largely ended, although old incidents are sometimes reported as if they were current events. The cessation of Venezuelan fishing is in large measure the result of the NACG's expanded enforcement capability.[348] The N.A. Government permits Venezuelan fishermen to sell their catch at a floating market (Punda) in Willemstad. The Venezuelan fishermen have free passage to enter N.A. ports as long as they do not fish in N.A. waters. If the fishermen are caught actually fishing (nets in the water), they will be seized. Otherwise they are permitted to enter the port and sell their catch.[349] There are some exceptions. Some Venezuelan fishermen have been granted permits to fish in N.A. waters, mostly for pelagic species. Under the terms of those permits, the Venezuelans are not allowed to land their catch in N.A. ports. The Venezuelan fish sold in Aruba and Curaçao is mostly demersal species taken in Venezuelan coastal waters. Allowing Venezuelan baitboats and purseseiners to sell their catches locally would have flooded the domestic market.[350] N.A. fishermen report that Venezuelan tuna purse seiners regularly pass north of Curaçao to and from the Panama Canal, but have not noted them setting in N.A. waters.[351]

B. Joint ventures

Some limited information is available on joint venture operations.

Japan: A Japanese company has conducted a longline operation out of St. Maarten for years. The company has generally leased foreign longliners (mostly Korean and Taiwan) vessels. The company frequently obtained Bermudian fishing licenses.[352] The catch was generally transhipped through subsidiary facilities of the large Japanese fishing company Nichirei in St. Maarten (initially Curaçao Pioneering and subsequently Nichirei Carib Corp.).

Taiwan: Taiwan, like the Japanese, initiated Caribbean-area longline operations in the 1960s. The primary Taiwan activity has been to the north of the Caribbean, as far as Bermuda, where they have targeted albacore to supply Puerto Rican canneries packing "white meat" tuna.[353] Tuna caught in the western Atlantic was during the 1980s transhipped through St. Maarten and to a lesser extent Aruba by Taiwan and other Asian longliners. Available evidence suggests that Taiwan longliners are not currently extensively fishing Caribbean waters, but are primarily using Caribbean ports to tranship their catch and maintain their fleet. Most of the Taiwan vessels have operated out of St. Maarten, but in the 1990s the transhipping operations at Port-of-Spain, Trinidad, became more important. Taiwan-owned vessels in the mid-1980s began expanding transhipping activities out of Port-of-Spain.[354] The vessels operating out of Port-of-Spain, however, are not as focused on albacore as the vessels operating out of St. Maarten. The Port-of-Spain vessels, however, do target albacore to the north of the Caribbean like many of the St. Maarten vessels have done.[355] None of the vessels appear to be currently active in the western Caribbean around the Netherlands Antilles.

Photo 22.--St. Maarten can be seen in this photograph from Anguilla. Most fishery incidents, however, with Anguilla involve fishermen from the French side of the island. Dennis Weidner

United States: The United States began developing a longline fleet targeting yellowfin tuna in the Gulf of Mexico. Beginning in the mid-1980s, U.S. longline fishermen began targeting

swordfish after commercial stocks were encountered off the Florida Atlantic coast.[356] A small number of the swordfish/tuna U.S. longliners are active in the wider-Caribbean, including grounds to the north and east, and to a lesser extent south of Puerto Rico. The U.S. fishery is highly seasonal, primarily conducted during the winter months. U.S. pelagic longline fishermen in the Caribbean often fish in the northeastern Caribbean, but generally to the southeast of Puerto Rico. There is minimal U.S. activity in the southern Caribbean around the Netherlands Antilles.[357]

C. Foreign aid

Generally high income levels and the N.A. status as a Dutch colony has meant that assistance from international donors has been limited. Much of the fisheries development assistance comes from the Dutch Government. FAO has also provided a number of valuable technical missions.

FAO: The FAO WECAF technical missions in the late 1970s and early 80s provided some valuable information on the effectiveness of various fishing gear, including longlines.[358]

Netherlands: The Netherlands has sponsored a variety of fishery development programs on the various islands.

Central Government: The Dutch provided a 2-week consultancy in 1989 to help formulate the Central Government's fisheries policy.

Bonaire: The Dutch provided funding for the Bonaire Koel en vrieshuis, before 1977. The boats to expand the local fishing were partly paid for by the N.A. Central Government.

Curaçao: The Netherlands in 1985 considered supporting a test fishing project using longlines and driftnets as well as deploying FADs. Only the FAD portion of the project, however, was actually executed. The Dutch in 1990 also funded the new fisheries harbor at Caracasbaai at a cost of $1.3 million. The Dutch paid for the first three MKI FADs which cost $25,000, but not their deployment. They have funded five MKII FADs which are being built at a cost of $55,000. Other FADs are being financed by the Curaçao Central Government. Dutch funding has been approved for two slipways at Sta. Cruz and Westpunt which will be in part used for fisheries.

Saba: The Dutch financed a Saba Bank stock assessment. A fishing vessel was leased for test fishing on Saba Bank.

St. Eustatius: The Dutch supported a fishery development project for Saba Bank.[359] The main project was the construction of a fish terminal at St. Eustatius which was financed by the Dutch.[360]

Overall: Several other projects were discussed as well, but never materialized.

World Wildlife Fund: The World Wildlife Fund and the EU has supported the development of underwater parks in Bonaire, Curaçao, and Saba through funding provided the CARMABI Foundation.

XVII. Enforcement

The Dutch Caribbean islands have a single unified coast guard. Despite the fact that Aruba separated from the Netherlands Antilles in 1986, the islands maintain many traditional ties. One such common institution is a still unified coast guard which was created after Aruba separated from the other islands. The N.A. Coast Guard (NACG) was established in 1995.

Most Caribbean countries declared 200-mile Exclusive Economic Zones (EEZs) in the 1970s and began to limit foreign fishing. The Netherlands did so in 1977.[361] The N.A. did not implement such controls at this time because of constitutional issues between the N.A. Central Government and the individual island governments.[362] As a result, N.A. waters (especially Saba Bank), became a refuge for foreign fishermen who were subject to catch restrictions in their domestic waters and denied access to other grounds. Finally in 1993, the N.A. established an EFZ which encompassed Saba Bank.

The NACG initiated patrols soon after it was established in 1995. Patrols in the Windward Group were at first limited, but occasional patrols of Saba Bank were begun in 1996. The NACG obtained a larger patrol boat in 1999 and has intensified patrols of offshore areas, including Saba Bank. Dutch officials are pleased with the results, but some concerns have been expressed. Much of the cost of the NACG has been born by the Dutch Government. Officials in 1998 complained that the N.A. Government was not paying its share. Local officials would like for the NACG to be more Antillian. Fisheries enforcement is only one of the NACG's responsibilities, but an important one.[363]

The NACG currently deploys three cutters which can stay at sea several days on an enforcement cruise. The *Jaguar, Panther, and Puma* are based in Aruba, Curaçao, and St. Maarten. The cutters are backed up with three Orions. A fourth is on order. Officials report that the NACG with its increased enforcement capability has substantially reduced illegal foreign fishing in recent years.[364]

N.A. officials have been particularly concerned about foreign fishing on Saba Bank, especially the northern and northeastern part of the bank where the Saban fishermen are most active. The fishermen complain about the theft of lobster traps. A variety of foreign fishermen are reportedly active there, using larger boats than those used by the Saban fishermen.[365]

Anguilla: Handliners from Anguilla are occasionally seen on Saba Bank. St. Maarten fishermen often fish in Anguillian waters, because the N.A. portion of Anguilla Bank is so small.

Costa Rica: Costa Rican authorities seized the N.A.-flag tuna seiner *El Caribe* in 1979.

Montserrat: Fishermen from Montserrat have been observed on Saba Bank.

French Islands: Fishermen from Guadeloupe and Martinique have been reported on Saba Bank.

St. Kitts: Handliners from St. Kitts are occasionally seen on Saba Bank.

United States: U.S. fishermen from St. Croix were reportedly setting traps on Saba Bank in the 1980s. N.A. officials report that they were new arrivals to the fishery. Officials were concerned that stricter management of Puerto Rican and Virgin Islands fisheries might be resulting in fishermen redirecting effort to other areas like Saba Bank.[366] This and other matters of mutual concern were discussed in 1982 by N.A. officials and representatives of the U.S. Caribbean Fisheries Management Council.[367] A U.S. Virgin Island fisherman was reported fishing illegally in 1999.[368]

Venezuela: Several incidents with Venezuelan fishermen have been noted. The most publicized, and now often cited, incident was when a artisanal Bonaire fisherman in 1980 had his small boat encircled by the net of a large Venezuelan purseseiner off the islands northern coast. A large Venezuelan boat was setting traps on Saba Bank in the 1980s.[369] Netherlands Antilles, Aruban, and Venezuelan vessels have fished in each others waters without limitations. An Aruban fisherman, however, without Government authorization threatened in 1988 to seize some Venezuelan boats. The Venezuelan Coast Guard subsequently began hassling Aruban fishermen.[370] The informal arrangements over fishing in Aruban/Netherlands Antilles waters appear to have changed with the formation of the NACG. One observer on Aruba reports that some Venezuelan vessels, both longliners and trawlers still fish illegally at night. Some have reportedly been seized and fined.[371] Another report indicates that a few Venezuelan longliners were seized in 1999.[372] The authors, however, have scant details and officials believe that extensive Venezuelan fishing has now ceased.[373] Venezuelans in the past have freely entered Aruba with out visa restrictions, in part to facilitate tourism. One report from Aruba suggests that authorities are concerned about recent incidents with Venezuelans bringing drugs into Aruba and are

planning to institute a new visa requirement.[374]

Enforcement is a particularly difficult problem for the Netherlands Antilles because the various Dutch Islands are scattered throughout the Caribbean at widely separated locations in the south central and northeastern Caribbean. The cost of any serious at seas enforcement effort is daunting, especially for the small Windward Group islands like St. Maarten and Saba. Another problem is that the Dutch do not participate in the OECS enforcement effort. The acquisition of a larger patrol boat in 1999 has significantly expanded the NACG's capability. The U.S. Coast Guard has been providing assistance in the establishment of the N.A. Coast Guard.[375] The Dutch cooperate with the United States and Britain which deploy enforcement platforms in the Caribbean. A U.S. trap fishing vessel, for example, was boarded in 1999 by a British Royal Navy vessel with a U.S. Coast Guard officer aboard. They were fishing illegally off Saba. They were required to pull their gear and leave the area and were inspected by NMFS agents when they returned to St. Croix, U.S. Virgin Islands.[376]

XVIII. Future Trends

Antillian officials have for some years desired to expand the local fishing industry and longlining is one fishing method that they have considered. Some thought has been given to longlining for tuna, swordfish, and other oceanic pelagics, which the local fishermen have not taken in quantity. The existing pelagic catch is mostly taken by trolling. There have been some test longlining. Curaçao officials have concluded that the development of offshore resources will require a domestic longline fishery which perhaps also employs other gear in combination with longlining.

The first serious Antillian steps to longline were reported in 1999. On Curaçao in the Leeward Group, one company in 1999 began experimental trials and in 2001 began full-scale commercial operations with a longliner imported from the United States. The company reports encouraging results. A second company fishes occasionally. A third company which has done some longlining may re-enter the fishery. Small-scale export shipments of fresh tuna and swordfish have been reported to the United States. Curaçao has been the center of the Antillian longline operations, although one longliner did for a time work out of Bonaire. The current longlining operations are currently only being conducted from Curaçao.

Antillian longline activities are still very limited. There are few Antillian fishermen experienced with longlining. The most successful operation has contracted a Canadian fishermen, but he had no longlining experience and is himself learning. The vessels owners are generally pleased with the progress and believe that their longline venture will be successful.

The authors have noted some limited interest in longlining on the Netherlands Antilles. It looks like one project will be successful. Two other vessel owners have yet to demonstrate the ability to conduct profitable operations. There is a strong domestic market for seafood on several islands, in part because of the tourist industry. This combined with easy access to the U.S. market suggest that the fishery is feasible. Foreign catch data suggests that the resource exists to support a small domestic fishery. The lack of trained captains and crews, however, will be a limiting factor. Given the initial success of one company, the Netherlands Antilles should report a small, but increasing catch of tunas, swordfish, and related species over the next few years. A few additional longliners are likely to be added to the fleet in the 2000s.

The authors have no information about the future of the Japanese company on St. Maarten which charters Taiwan longliners. The operation appears to have been fairly stable at about 20-25 taiwan longliners in recent years. Shipments of albacore tuna have declined slightly in 2000, but have been relatively stable since 1996. Some reports suggest that the vessels and processing plants are aging and in need of upgrading. Less information is available on the St. Maarten operation than the Taiwan transhipment facilities on Trinidad which show no sign declining activity. The authors believe that the St. Maarten operation is unlikely to increase dramatically in scale, but is likely to continue operations at the current level for the foreseeable future.

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Endnotes

SECTION I. (Overview)

1. J. Sybesma and M.A. Borowitzka, "Marine resource protection versus marine tourism in Curaçao: A management problem," *Proceedings of the Sixth International Coral Reef Symposium*, Townsville Australia, August 8-12, 1988, Vol. 2 Contributed Papers, 1988, pp. 411-414.
2. G. Van Buurt, Head, Curaçao Fisheries Section, personal communications, September 10, 1985.
3. Van Buurt. *op. cit.*, September 10, 1985.
4. Van Buurt, *op. cit.*, April 25, 2001.
5. Jacques S. Zaneveld, "The sea fisheries of the Netherlands Antilles," *Collected Papers*, No. 17 (Caribbean Marine Biological Institute: Trinidad, 1960), p. 14. The report by Zaneveld is widely regarded as the seminal study on the fisheries of the Netherlands Antilles. U.S. readers might find it easier to obtain a slightly revised version that was published by the Gulf and Caribbean Fisheries Institute in 1962. Jacques S. Zaneveld, "The fishery resources and fishery industries of the Netherlands Antilles," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 14 (GCFI: 1962), pp. 137-171.
6. Charles Finan, "The fisheries of the Netherlands Antilles," *International Fisheries Report* (IFR-81/136), July 29, 1981, p. 1.
7. Finan, "The fisheries ...," *op. cit.*, p. 1.
8. P. Lorance, "La ciguatoxicitè des poissons sur les bancs de Saint Barthelemy, Saint Martin et Anguilla," *Document Scientifique*, No. 15, Pole Caraibe, July, 1988.
9. Ron Rinaldo, NMFS, personal communications, May 16, 2001.
10. Finan, "The fisheries ...," *op. cit.*, p. 4.
11. CARMABI has been active in the Netherlands Antilles on a variety of environmental issues. Papers by CARMABI researchers have described many of these environmental problems. See for example: Adolphe O. Debrot, John E. Bradshaw, and Aubrey B. Tiel, "Tar contamination on beaches in Curaçao, Netherlands Antilles," *Pergamon Marine Pollution Bulletin*, Vol. 30, no. 11, 1995, pp. 689-693 and Adolphe O. Debrot, Aubrey B. Tiel, and John E. Bradshaw, "Beach debris in Curaçao," *Pergamon Marine Pollution Bulletin*, Vol. 38, no. 19, 1999, pp. 795-801.
12. Both in Curaçao and Bonaire, the practice of dumping garbage in the sea ended some time ago. One reports suggest 1986 on Curaçao and somewhat later on Bnaire. All solid wastes are now being buried in landfills. On Aruba, waste is being burned on land, in the open air. Van Buurt, *op. cit.*, July 23, 2001.
13. The effluent problem of open sewers has been solved on Curaçao. Two sewage treatment plants have been built. The plant at Klein Hofje was built some time ago. The plant at Klein Kwartier was open in early 2001. The treated water is used for agriculture and for golf courses. Officials report that this way the nutrient loads are dissipated. Aruba has a similar sewer treatment plant at Bubali. Van Buurt, *op. cit.*, July 23, 2001.
14. A.O. Debrot and J. Sybesma, "Chapter 38. The Netherlands Antilles," in C.R.C. Sheppard (ed.), *Seas at the Millennium: An Environmental Evaluation, Vol. I Regional Chapters: Europe, The Americas and West Africa* (Pergamon Press: Amsterdam, 2000) pp. 595-614.
15. Van Buurt, *op. cit.*, September 10, 1985.
16. Alfredo Pichardo, Teaser Charters, personal communications, April 10, 2001.

SECTION II. (Species)

17. Charlene Grall and Donald P. de Sylva, "Distribution, relative abundance, and seasonality of swordfish larvae," *Transactions of the American Fisheries Society*, Vol. 112, 1983, 239, 243-244.
18. John Jeffrey Govoni, Bruce Stender, and Oleg Pasuk, "Distribution of larval swordfish, *Xiphias gladius,* and probable spawning off the southeastern United States," in press, advanced copy provided the authors in November 1998.

SECTION III. (Grounds)

19. For simplicity the Dutch names Sint Eustatius and Sint Maarten will be referred to as St. Eustatius and St. Maarten which is more familiar to U.S. readers.
20. Both the French and the Dutch posses part of the same island. The northern French section is St. Martin, the southern Dutch section is Sint Maarten. French St. Martin is administratively part of the French Overseas Department of Guadeloupe.
21. Zaneveld, "The sea fisheries ...," *op. cit.*, p. 4. A more precise explanation of geological formation of Curaçao and other Caribbean islands is available in D.K. Larue, A.L. Smith, J.H. Schellekens, "Oceanic island arc stratigraphy in the Caribbean region: Don't take it for granite," *Sedimentary Ceology*, Vol. 74, No. 1, 1991, pp, 289-308.
22. One author avoids this confusion by referring to the Windward group as the Southern Caribbean. We have chosen to use Windward Group because much of the available fisheries literature uses this term.
23. J. Roullot, "Report on mission to the Netherlands Antilles (Bonaire)," *WECAF Reports*, No. 33 (WECAF: Panama, August, 1980), p. 12.
24. Debrot, *op. cit.*, August 9, 2001.
25. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 2.
26. Van Buurt, *op. cit.*, July 23, 2001.
27. For a good overview see Debrot and Sybesma, "Chapter 38. The Netherlands Antilles," *op. cit.*
28. M.M.C.E. Kuenen, and A.O. Debrot, "A quantitative study of the seagrass and algal meadows of the Spanse Water, Curaçao, the Netherlands Antilles," *Aquatic Boyony*, Vol. 51, No. 3-4. 1995, pp. 291-310.
29. Zaneveld, "The sea fisheries ...," *op. cit.*, p. 4.
30. One author avoids this confusion by referring to the Windward group as the Lesser Antilles. We have chosen to use Windward Group because much of the available fisheries literature uses this term.
31. Debrot, *op. cit.*, August 9, 2001.
32. D. Voltolina, "Hydrological conditions of the central zone of the Venezuelan Caribbean Sea," in *Book of Abstracts of Papers Presented at the Joint Oceanographic Assembly* (Edinburgh, U.K., September 13014, 1976) (FAO: Rome, 1976). Another good source is an article by M.G. de L. Strum. He provides an excellent general fisheries overview and gives considerable attention to the upwelling section. M.G. de L. Sturm, "The living resources of the Caribbean Sea and adjacent regions," *Caribbean Marine Studies*, Vol 2, 1991, pp. 18-44.
33. M.L.J. van Veghel and P.C. Hoetjes, "Effects of tropical storm Bret on Curaçao reefs," *Bulletin of Marine Science*, Vol. 56, No. 2, 1995, pp. 692-694.
34. Gerard Van Buurt, "The fisheries situation in the Netherlands Antilles," unpublished study prepared by the Netherlands Antilles Fisheries Section, September, 1979.
35. Roullot, "Report on mission ...," *op. cit,*, p. 1.
36. Arie Zuurmond, Blue Caribbean Seafood, personal communications, April 9, 2001.
37. G. Van Buurt, "The fisheries situation in Saba and St. Eustatius," report prepared by the Fisheries Section, September, 1980, pp. 3-4.
38. Van Buurt, "The fisheries situation in Saba ...," *op. cit.*, p. 1.
39. In the past it was believed that ciguatera was caused by copper.
40. The area affected, however, are not well defined, in part because the fishermen avoid large areas. Van Buurt, "The fisheries situation in Saba ...," *op. cit.*, p. 2.
41. Finan, "The fisheries ...," *op. cit.*, p. 3.
42. Departement van Volksgezondheid en Milieuhygiene, "Saba Bank," internet site posted March 29, 2000: http://mina.vomil.an/Eilandinfo/Sababank.html. A more detailed assessment of the Saba Bank fishery is with details on the Bank and fishery as well as the ciguatera problem is available in F. Dilrosun, *Monitoring the Saba Bank Fishery* (NA Department of Public Health and Environmental Hygiene: Curaçao, October 2000).

SECTION IV. (Fleet)

43. Finan, "The fisheries ...," *op. cit.*, p. 2.
44. Juhl, *op. cit.*, March 25, 1988.
45. Ron Rinaldo, NMFS, personal communications, May 16, 2001.
46. Finan, "The fisheries ...," *op. cit.*, p. 1.
47. Finan, "The fisheries ...," *op. cit.*, pp. 1-2.

48. Rolf Juhl, NMFS, memorandum, March 25, 1988.
49. Arie Zuurmond, Blue Caribbean Seafood, personal communications, March 23, 2001.
50. Zuurmond, *op. cit.,* April 9, 2001.
51. Cor Gouw, Blue Caribbean, personal communications, July 5, 2001.
52. Zuurmond, *op. cit.*, April 9, 2001.
53. Gerard van Buurt, Fisheries Section, personal communications, April 3, 2001.
54. Rinaldo, *op. cit.*, May 16, 2001.
55. Teaser Charters, "Teaser Charters," internet site accessed March 27, 2001: http://teasercharters.com/about/index.html; Cpt. Medina, "Rainbow Runner bottom fishing," intetnet site accessed March 27, 2001: http://www.rainbowseekers.com/; Aruba Luxury Condos, "Deep sea fishing in Aruba," intetnet site accessed March 27, 2001: http://www.arubaluxurycondos.com/activities.htm; and MahiMahi Charters, "Aruba deepsea fishing," internet site posted November 6, 2000: http://www.aruba-mahimahi.com/
56. Big Game Sport Fishing, "Big Game Sportfishing," internet site accessed March 27, 2001: http://www.bonairenet.com/biggame/indexbgs.htm
57. Fishing Bonaire, "Deep sea fishing," internet site accessed March 27, 2001: http://fishingbonaire.com/index.htm
58. Curaçao Travel Guide.com, "Curacao--TravelGuide, scuba diving, deepseafishing, and other sports," internet site posted January 29, 2001: http://www.curacao-travelguide.com/activities and J.P. Van der Lubbe, "Team Just Us origins," internet site posted in 2001: http://www.antillean.net/origins.htm
59. Saba Tourist Office, "Sport fishing & charter operation aboard the "Reality," internet site accessed March 29, 2001: http://www.turq.com/saba/saudate1.html
60. Deep-Sea Sportfishing Charter Boat Service, "St. Maarten Deepsea Sportfishing Marlin Charter," internet site accessed March 27, 2001: http://marlin.hypermart.net/deepseafishing.html
61. Rolf Juhl, NMFS, memorandum, March 25, 1988.
62. The authors have attempted to compile an appendix listing data on the vessels transshipping at St. Maarten. As little data was available under the vessel names supplied by St. Maarten port authorities, we have included data on vessels that could have involved, but have slightly different names. It is possible that the differences are associated with the difficulties in transliterating Chinese characters. Other factors, however, may also be involved.
63. Bernhard Komproe, Director of the Department of Shipping and Maritime Affairs, Presentation at ICCAT annual meeting, November 13, 2000.
64. Van Buurt, *op. cit.*, April 25, 2001.
65. The Green Peace report cited vessel data from Lloyds. Green Peace--Spain, "Pesca pirata," internet site assessed May 3, 2001: http://www.greenpeace.es/biodiversidad/bio_2c.htm
66. N.A. references to extended jurisdiction tend to refer to a 200-mile Exclusive Fishing Zone (EFZ) rather than a Exclusive Economic Zone (EEZ). Many countries which originally issued EFZs have since converted to EEZs. The authors are unsure why the N.A. still maintains an EFZ.
67. Anonymous NA source, personal communications, May 3, 2001.
68. Komproe, *op. cit.*, November 13, 2000.
69. For additional information on ICCAT membership see "XVI. International".
70. Van Buurt, *op. cit.*, July 30, 2001.
71. Anonymous N.A. official, personal communications, February 6, 2001.
72. There is a difference of opinion within the N.A. Fisheries Service. While some officials advise against joining ICCAT, others reportedly see some benefit to membership. Some believe that membership would help influence ICCAT decisions.
73. Anonymous N.A. official, personal communications, February 6, 2001.

SECTION V. (Shipyards)

74. Gerard Van Buurt, "Fisheries Netherlands Antilles -- Development of fisheries Western Central Atlantic," unpublished report prepared by the Netherlands Antilles Fisheries Section, August, 1975, p. 1 and *Directory of Information: Ports of Curaçao*, 1985.
75. Finan, "The fisheries ...," *op. cit.*, p. 2.

SECTION VI. (Fleet Operations and Gear)

76. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 2.

77. Juhl, *op. cit.*, March 25, 1988.
78. Pichardo, *op. cit.*, April 10, 2001.
79. G. Van Buurt, "Artisanal fisheries in the Netherlands Antilles: Fishery development planning," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 36 (GCFI: Miami, Florida, 1984), p. 45.
80. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 1.
81. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
82. Juhl, *op. cit.*, March 25, 1988.
83. Van Buurt, "The fisheries situation ..., *op. cit.*, p. 1.
84. Van Buurt, "The fisheries situation in Saba ...," *op. cit.*, p. 1.
85. Van Buurt, "The fisheries situation in Saba ...," *op. cit.*, p. 3.
86. Van Buurt, "Artisanal fisheries ...," *op. cit.*, p. 45.
87. Andy Caballero, Marine Park Manager, Nature Foundation, personal communication, June 5, 2001.
88. Craig Theriault, Blue Caribbean Seafood, Captain of the longliner *Bigeye*, personal communications, April 27, 2001.
89. Theriault, *op. cit.*, April 27, 2001.
90. Zuurmond, *op. cit.*, April 9, 2001.
91. Theriault, *op. cit.*, April 27, 2001.
92. Much of the fisheries research conducted in the Netherlands Antilles focuses on these reefs and the species associated with them. One subject of concern is the impact of recreational diving on the reefs. See for example, J.P. Hawkins, C.M. Roberts, T. Van't Hof, K. deMeyers, J. Tratalos, and C. Aldam, "Effects of recreational diving on Caribbean coral and fish communities," *Conservation Biology*, Vol. 13, No. 4, August 1999, pp. 888-897.
93. IGFA, "International tournament calendar," *The International Angler*, September-October, 1996, p. 15.
94. Peter Creutzberg, "Welcome aboard," internet site posted November 6, 2000: http://www.aruba-mahimahi.com/captain/index.shtml. On another page in the same site, blue marlin is described as a species that is regularly caught.
95. Teaser Charters, "Teaser Charters," internet site accessed March 27, 2001: http://teasercharters.com/about/index.html and Alfredo Pichardo, Teaser Charters, personal communications, March 27, 2001.
96. Pichardo, *op. cit.*, April 10, 2001.
97. Piscatur, "Piscatur fishing charters," internet site posted in 1998: http://www.bonairetours.com/piscatur/about.html
98. Big Game Sport Fishing, "Big Game Sportfishing," *op. cit.*
99. Fishing Bonaire, "Deep sea fishing," *op. cit.*
100. Curaçao Yacht Club, "Luhrs 35th annual International Blue Marlin Tournament," internet site accessed March 27, 2001: http://www.caribseek.com/yachtclub/aboutthe tournament.html
101. Saba Tourist Office, "Sport fishing & charter operation aboard the "Reality," *op. cit.*
102. Larry Larsen, "Fishing Dutch--St. Maarten deep sea action," internet site accessed April 2, 2001: http://www.edersfishing.com/salt/publication/2000/April/StMaarten/default.cfm
103. The fact that the tournament name includes both the French and Dutch names means that it is a joint tournament held island wide.
104. ICCAT, "Quarterly highlight report of the ICCAT Enhanced Research Program for Billfish," July-September, 1993, p. 3.
105. Bonaire Fishing, "Bonaire fishing," internet site posted in 1999: http://www.bonairefishing.com/
106. Van Buurt, *op. cit.*, April 25, 2001.
107. Rolf Juhl, NMFS, memorandum, March 25, 1988.
108. Mark. R. Wildman, "Taiwan," Ch. 4 in *World Swordfish Fisheries,* Vol. III (NMFS: Silver Spring, Maryland, 1997), pp. 106-144.

SECTION VII. (Catch)

109. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 2.
110. Faisal Delrosun who did the detailed report on the Saba Bank cited in this report is coordinating the data collection for the Fisheries Section.
111. Van Buurt, *op. cit.*, April 3, 2001.

112. E.D. Prince, "Progress of the ICCAT Enhanced Research Program for Billfish in the western Atlantic Ocean during 1990," *ICCAT Collective Volume of Scientific Papers*, (SCRS 90/20) Vol. 35, No. 1 (ICCAT: Madrid, 1991), pp. 69-72.
113. Van Buurt, *op. cit,* April 9, 2001.
114. Arie Zuurmond, Blue Caribbean, personal communications, March 23, 2001.
115. Van Buurt, *op. cit.*, April 3, 2001.
116. Van Buurt, *op. cit.*, April 18, 2001.
117. While Taiwan shipments through St. Maarten to Puerto Rican canneries were highly variable during the 1980s and 90s, imports reported in Puerto Rico from Taiwan continued at high levels throughout this period (Puerto Rico, appendix F4). This shows that Taiwan fishermen continued their fishing operations, even though in several years they varied transshipping points.
118. Van Buurt, *op. cit.*, April 3, 2001.
119. Zuurmond, *op. cit.*, March 23, 2001.
120. Van Buurt, *op. cit.*, April 18, 2001.
121. Zuurmond, *op. cit.*, March 23, 2001.
122. Van Buurt, *op. cit.*, April 3, 2001.
123. Zuurmond, *op. cit.*, April 9, 2001.

SECTION VIII. (Ports)

124. Rinaldo, *op. cit.*, May 16, 2001.
125. Van Buurt, *op. cit.*, September 10, 1985.
126. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 1.
127. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
128. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
129. Van Buurt, "The fisheries situation in Saba ...," *op. cit.*, p. 1.
130. "Central Caribbean location makes island's marine trade industry one of the best," *Washington Times*, March 22, 2000.
131. Joe Martin and Bill Wood, "ABC to hit longliners," *San Juan Star*, March 27, 1987.

SECTION IX. (Transshipments)

132. Pichardo, *op. cit.*, April 10, 2001. Pichardo reports that the vessels may have bee operating out of the Venezuelan port of Corúpano. The authors know of no Taiwan-Venezuelan joint venture in the mid-1980s. There was, however, a Korean-Venezuelan joint venture based in Corúpano. For details, see the Venezuelan chapter of this report.
133. Pichardo, *op. cit.*, June 28, 2001.
134. Juhl, *op. cit.*, March 25, 1988.
135. Pichardo, *op. cit.*, April 10, 2001.
136. Juhl, *op. cit.*, March 25, 1988.
137. Van Buurt, *op. cit.*, April 4, 2001.
138. ICCAT, "Report of the Sub-Committee on Statistics," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), p. 201.
139. ICCAT, "Progress of the Enhanced Research Program for Billfish during 1989," *ICCAT Report*, 1988-89, Part I, (ICCAT: Madrid, Spain, 1989), p. 240 and ICCAT, "Program plan for the ICCAT Enhanced Research Program for Billfish - 1991," *ICCAT Report*, 1990-91, Part I, (ICCAT: Madrid, Spain, 1991), p. 395.
140. ICCAT, "Program plan for the ICCAT Enhanced Research Program for Billfish - 1991," *ICCAT Report*, 1990-91, Part I (ICCAT: Madrid, Spain, 1991), p. 395.
141. ICCAT, "Progress of the Enhanced Research Program for Billfish during 1989," *ICCAT Report*, 1988-89, Part I, (ICCAT: Madrid, Spain, 1989), p. 240.
142. ICCAT, "Report on statistics and coordination of research in 1993," COM-SCRS/93/12, *ICCAT Report* Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 26.
143. U.S. Consulate General, Hamilton, "Japanese tuna fishing off Bermuda," message number 575, October 30, 1979.
144. For details see the Bermuda chapter of this report.
145. Mark Farber, NMFS, personal communications, May 9, 2000.

146. For reasons that the authors do not fully understand, many of the vessels operating from St. Maarten do not show up on the lists of vessels consulted. Some of the problem may be transliteration and the authors have found information on possible alternative names (appendix A3). Some of these vessels were built as recently as 1997.
147. Freddy Arocha, Universidad de Oriente, personal communications, May 31, 1999.
148. These two reports are discussed in greater detail in the billfish section of "XV. Bycatch".
149. The albacore was mostly transhipped through St. Maarten to Puerto Rico and the billfish to other foreign markets. Juhl, *op. cit.*, March 25, 1988.
150. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56.
151. These estimates are based in the fact that in Trinidad the Taiwan albacore landings were about 25 percent of their total landings (appendix C2a). Of course this is just speculative projection as the catch composition landed on St. Maarten could be quite different. The quantity shipped to the United States, mostly albacore, is known. The bigeye is mostly shipped to Japan, but the quantities involved are unknown.
152. Swordfish is often about 5-15 percent of tuna catches in directed tuna fisheries. This varies from country to country, grounds, seasons, and target species. The authors note that in Trinidad, swordfish as about 8 percent of the Taiwan albacore landings. If that same ration was applied to St. Maarten, there would have been over 600 t of swordfish associated with the nearly 8,000 t of albacore imports. Reports from St. Maarten, however, suggest that greater quantities of swordfish may be involved (appendix C4a). As this is frozen product, little is exported to the United States and thus, unlike the albacore, there is no hard data.

SECTION X. (Processing and Products)

153. Zuurmond, *op. cit.*, April 9, 2001.

SECTION XI. (Companies)

154. Loes P. de Bot, Overseas Tuna Company, FAX to ICCAT, March 24, 1998.
155. Julio C. Philips, Commercial Attache, personal communications, July 11, 1988.
156. Arie Zuurmond, Blue Caribbean, personal communications, March 23, 2001.
157. Cor Gouw, Blue Caribbean, personal communications, August 29, 2001.
158. Zuurmond, *op. cit.*, March 23, 2001.
159. Gouw, *op. cit.*, July 5, 2001.
160. Zuurmond, *op. cit.,* April 9, 2001.
161. Van Buurt, "Fisheries Netherlands Antilles ...," *op. cit.*, p. 1.
162. Van Buurt, "Fisheries situation ...," *op. cit.*, p. 3.
163. U.S. Consulate General, Curaçao, "Pirate whaling," message number 227, March 13, 1980.
164. Finan, "The fisheries ...," *op. cit.*, p. 4.
165. Van Buurt, *op. cit.*, April 9, 2001. The minimal shipments reported by the EU since 1995 may reflect a change in the EU statistical system rather than a change in the actual pattern of transhipments.
166. ICCAT, "ICCAT Enhanced Research Program for Billfish: 2000 expenditures/contributions, program highlights & program plan for 2001," appendix 8, 2000: http://www.iccat.es/Documents/EBRF.pdf
167. The EU classifies the Netherlands Antilles as a category two entity in such matters. The Overseas Tuna Company reports that Government officials hope to improve their standards in several areas which will allow them to gain category one status. Elisa Inkel, Supervisor, Overseas Tuna Company, personal communications, August 3, 1999.
168. Inkel, *op. cit.*, August 3, 1999.
169. U.S. Consulate General, Curaçao, "Whaling activities of fishing vessel Tonna," message number 670, September 13, 1970.
170. Henry Veeris-Visser, Manager, Veeris-Visser Import, personal communication, January 11 and February 21, 1977.

SECTION XII. (Markets)

171. Pichardo, *op. cit.*, April 10, 2001.
172. Rinaldo, *op. cit.*, May 16, 2001.

173. Van Buurt, "The fisheries situation, *op. cit.*, p. 1.
174. Van Buurt, *op. cit.*, September 10, 1985.
175. Van Buurt, *op. cit.*, April 25, 2001.
176. Zaneveld, "The sea fisheries ...," *op. cit.*, p. 5.
177. Finan, "The fisheries ...," *op. cit.*, p. 3 and Van Buurt, *op. cit.*, April 25, 2001.
178. Caballero, *op. cit.*, June 29, 2001.
179. Van Buurt, *op. cit.*, April 5, 2001.
180. Pichardo, *op. cit.*, April 10, 2001.
181. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
182. T. Van't Hof, A.O. Debrot, and I.A. Nagelkerken, *Curaçao Marine Management Zone: A Plan for Sustainable Use of Curaçaos Reef Resources*, draft plan for consultation (CTDB/STINAPA: 1995), 89p plus appendices.
183. A Curaçao researcher reports that sharks used to be commonly seen off Curaçao. He has, however, only seen one shark during diving along the island's coast in the last 11 years! In contrast, while diving in pristine unfished reefs in the Exumas (Bahamas) he saw sharks every day during many visits while diving as part of field work. Debrot, *op. cit.*, August 9, 2001.
184. Accepted international statistical practice would be to classify the transhipments under the flag of the vessel which caught the fish rather than the port from which it was shipped. Thus the transshipments would included with Taiwan, Honduras, Panama, Venezuela, or other country rather than the Netherlands Antilles.
185. U.S. accepts the international norm that imports should be classified by the flag of the vessel which caught the fish. In practice, however, Customs often records the port from which the product was shipped.
186. Based on conversations with Fisheries Officer Henri Girigorie. Van Buurt, *op. cit.*, April 25, 2001.
187. For details see U.S. Department of State, "Tuna fleet conformance with U.S. marine mammal regulations," message number 150278, June 9, 1981; U.S. Consulate General, Curaçao, "Intermediate embargo of tuna," message number 525, May 8, 1989; U.S. Department of State, "Intermediary yellowfin tuna embargo," message number 254617, August 7, 1992; and U.S. Consulate General, Curaçao, "Intermediary nation yellowfin tuna embargo," message number 1506, November 20, 1992; and P.J.M. de Bruijn, Inspector of Shipping and Navigation, letter to Terry L. Leitzell, Assistant Administrator for Fisheries, March 18, 1980.
188. Van Buurt, *op. cit.*, April 25, 2001.
189. For details see "IX. Transshipments".
190. Purseseines,like virtually any fishing gear except harpooning, results in a bycatch. The bycatch from purseseine operations can be substantial. The dolphin bycatch is the best publicized, but a wide range of other species including sharks and billfish are taken. Normally swordfish is not a significant component of the bycatch, in part because unlike billfish swordfish do not school. Thus it would be unusual to take more than one swordfish in a set. Large purseseines with deep nets (240-270 m) can experience substantial billfish bycatches. Research conducted in the eastern tropical Pacific reveals that sharks are quite common, but that many other species like billfish are only in about 10 percent of catches. D.W. Au, "Polyspecific nature of tuna schools: Shark, dolphin, and seabird associates," *Fishery Bulletin*, Vol. 89, no. 3, 1991, pp. 343-354 and D.W. Au, NMFS, personal communications, May 9, 2001. Another useful assessment of purseseine bycatches is M.A. Hall, "Bycatches in purse-seine fisheries," in T.J. Pitcher and Rattana Chuenpagdee, eds, *Bycatches in Fisheries and Their Impact on the Ecosystem*, 1995, pp. 53-58.
191. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
192. Juhl, *op. cit.*, March 25, 1988.

SECTION XIII. (Government Policy)

193. Van Buurt, *op. cit.*, April 4, 2001.
194. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
195. Coral Reef Management Ordinance, 1976.
196. Draft No. 2 of Fisheries Ordinance, 1991.
197. Van Buurt, *op. cit.*, April 25, 2001.
198. The initial law was the Territorial Sea (Demarcation) Act, June 1, 1985. Notice to Mariners 49/85, December 1, 1985, extended the limit to the Netherlands Antilles.
199. Royal Decree, October 23, 1985, December 1, 1985.
200. Royal Decree, December 25, 1977.
201. U.S. Consulate General, Curaçao, "Netherlands-Venezuela boundary treaty," message number A-07, April 4, 1978.

202. The Netherlands on July 29, 1994 also signed Part XI Agreement and ratified it June 28, 1996.
203. Note verbale No. 9085, September 22, 1993.
204. *Official Journal of the Kingdom*, 1995, December 12, 1995, 664.
205. As mentioned above, the authors are unsure as to why the N.A. established an EFZ rather than an EEZ.
206. Van Buurt, *op. cit,* April 25, 2001.
207. Van Buurt, "Fisheries Netherlands Antilles ..., *op. cit.*, p. 2.
208. Van Buurt, "Artisanal fisheries ...," *op. cit.*, p. 45.
209. Van Buurt, "Fisheries Netherlands Antilles ...," *op. cit.*, p. 2.
210. Bernard O. Schmidt, Agricultural Project--St. Eustatius, personal communications, March 20, 1990.
211. Van Buurt, "The fisheries situation ...," *op. cit.*, p. 3.
212. Van Buurt, "Artisanal fisheries ...," *op. cit.*, pp. 47-48.
213. Gerald Van Buurt, "The Netherlands Antilles small-scale fisheries program," submission to IOCARIBE meeting, August 7-11, 1978.
214. M. Giudicelli, "Programme for fisheries development and diversification in the southern Netherlands Antilles: Aruba, Curaçao and Bonaire," *WECAF Reports*, No. 32 (WECAF: Panama, August 1980), 43p.
215. Van Buurt, "Fisheries Netherlands Antilles ...," *op. cit.*, p. 2.
216. Finan, "The fisheries ...," *op. cit.*, p. 3.
217. Van Buurt, *op. cit.*, September 10, 1985.
218. G. van Buurt, *The Construction and Deployment of Deep Water Fish Aggregating Devices in the Island of Curaçao*, RLAC/95/14-PES-25 (FAO: Santiago, Chile, 1995), 41p.
219. "Development Bank lowers interest rate," *The Daily Herald Newspaper Online,* 1998: internet posting: http"//www.thedailyherald.com/news/daily/121/dbna121.html
220. A.O. Debrot and J. Sybesma, "Chapter 38. The Netherlands Antilles," in C.R.C. Sheppard (ed.), *Seas at the Millennium: An Environmental Evaluation, Vol. I Regional Chapters: Europe, The Americas and West Africa* (Pergamon Press: Amsterdam, 2000) pp. 595-614.
221. A.O. Debrot and I. Nagelkerken, "User perception on coastal resource state and management options in Curaçao," *Rev. Biol. Trop.*, 48 Suppl. I., 2000, pp. 95-196.
222. Curaçao Agricultural Service, *Kumbre Agríkola 2000: Relato Final* (Curaçao: 2000), 36p. The conference was held May 20-June 4, 2000 to address fisheries and agricultural issues on Curaçao.
223. Fisheries Section, "Section of Fisheries," internet site posted January 25, 1998: http://www.arubaagricultureandfish.com/Fisheries.html
224. Van Buurt, *op. cit.*, July 25, 2001.
225. Nature Forum, "Declaration of the 3rd National Nature Forum of the Netherlands Antilles, Curaçao, August 28-30, 2000: http://mina.vomil.an/NANCI/declaration.html

SECTION XIV. (Research)

226. If the authors were to address the research on coral reefs and associated species, the overview would show much more activity than the very limited activity on pelagic species.
227. G. van Buurt, "Implementation of an ongoing FAD program in Curaçao (Netherlands Antilles) during the period 1993-2000," *Pêche Thoniere et Dispositifs de Concentration de Poissons--Actes de Colloques* (IFREMER: Brest, 2000), pp. 230-249.
228. Buurt, *The Construction ..., op. cit.*
229. CARMABI, "CARMABI," unpublished report prepared for an IOC mission, January 1985.
230. Kuenen and Debrot, "A quantitative study ...," *op. cit.*
231. Adolphe O. Debrot, Head of Research and Subdirector, CARMABI, personal communications, May 10, 2001.
232. See http://www.curacao.com/carmabi.
233. Jeannette Pot, Curaçao Sea Aquarium, personal communications, June 29, 2001. Ms. Pot indicated that the Aquarium Manager David van Bergen would provide details on the research program. Unfortunately at the time of publication no such details were received. The authors have learned, however, of at least one research program underway, a Ph. D. project beginning in October 2001, titled: "Ex-situ breeding of hermatypic Scleractinia--A contribution to reduce natural collection, and to establish coordinated breeding programs".
234. Sybesma and Hoetjes, "First record ...," *op. cit.*, p. 103.
235. Fisheries Section, "Section of Fisheries, *op. cit.*
236. R.R. Hensen, "Development of aquaculture in the Netherlands Antilles and Aruba," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 40 (GCFI: Miami, 1987), pp. 363-366.

237. Van Buurt, *op. cit.*, April 25, 2001.
238. Sybesma and Borowitzka, "Marine resource protection," *op. cit.*
239. The Netherlands Antilles National Park Foundation is headquartered on Curaçao (now merged with CARMABI) and is a completely separate organization than the National Park Foundation of Bonaire.
240. Lee H. Harris, "Summary of activities and capabilities: Florida Institute of Technology," in Brown, Erb, and Maul, ed. *Intra-Americas Sea Marine Science Meeting of U.S. Experts* (NMFS: Miami, 1992), p. 90.
241. B.E. Brown, E. Prince, and P. M. Miyake, "Progress of the ICCAT enhanced research program for billfish during 1987," SCRS/87/18
242. ICCAT, "Quarterly highlight report of the ICCAT Enhanced Research Program for Billfish," October-December, 1993, p. 2.
243. L. Reyal, G. van Buurt, and M. Taquet, "Perspectives de devloppement des DCP ancres dans les Petites Antilles. L'exemple de trois isles: Guadeloupe, Martinique et Curaçao," *Pêche Thoniere et Dispositifs de Concentration de Poissons--Actes de Colloques* (IFREMER: Brest, 2000), pp. 36-54.
244. Van Buurt, *op. cit.*, April 25, 2001.
245. Pacagoula Lab, Southeastern Fisheries Science Center, NMFS, "R/V Oregon II--Cruise 22, October 20-December," cruise announcement, December 11, 1970.
246. One example describes a study conducted in Puerto Rico. R.P. Van Dam and C.E. Diez, "Caribbean hawksbill turtle morphometrics," *Bulletin of Marine Science*, Vol. 62, No. 1, 1998, pp. 145-155.
247. C. Gomes, H.A. Oxenford, and R.B.G. Dales, "Mitochondrial DNA D-loop variation and implications for stock structure of the four-wing flying fish, *Hirundichthys affinis*, in the central western Atlantic," *Bulletin of Marine Science*, Vol. 64, No. 3, May 1999, pp. 485-500; H.A. Oxenford, R. Mahon, and W. Hunte, "Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean, I. Adults," *Mar Ecol Progr. Ser*, Vol. 11, 1995, pp. 11-23; W. Hunte, H. Oxenford, and R. Mahon, "Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean, II. Spawning substrata, eggs and larvae," *Mar Ecol Progr. Ser*, Vol. 11, 1995, pp. 25-37; and H. Oxenford, R. Mahon, and W. Hunte, "Distribution and relative abundance of flyingfish (Exocoetidae) in the eastern Caribbean, III. Juveniles," *Mar Ecol Progr. Ser*, Vol. 11, 1995, pp. 39-45.
248. ICCAT, "Program of the Enhanced Research Program for Billfish during 1988," *ICCAT Report*, 1988-89, Part I, (ICCAT: Madrid, Spain, 1989), p. 232.
249. ICCAT, "Report of the Special Group on Statistical Priorities," *ICCAT Report*, 1988-89, Part I, (ICCAT: Madrid, Spain, 1989), p. 286.
250. Debrot, *op. cit.*, May 19, 2001.
251. ICCAT, "Quarterly highlight report of the ICCAT Enhanced Research Program for Billfish," July-September, 1993, *op. cit.*, p. 3.
252. ICCAT, "Program plan for the ICCAT Enhanced Research Program for Billfish - 1991," *op. cit.*, p. 395.
253. ICCAT, "ICCAT Enhanced ...," *op. cit.*, p. 4.
254. "Cutback in Soviet ship visits to island decreed," *NRC Handelsblad*, May 7, 1981.
255. "USSR ships limited to 2-day stay in Willemstad," Paris broadcast, AFP 0146 GMT, February 11, 1981.
256. Debrot, *op. cit.*, May 10, 2001.
257. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.

SECTION XV. (Bycatch)

258. Zuurmond, *op. cit.*, April 9, 2001.
259. Zuurmond, *op. cit.*, April 9, 2001.
260. Taiwan transhipments in Trinidad during 1993 showed albacore was about half of tuna transhipments and larger than the total of yellowfin and bigeye (appendix C2a). Target species, however, change over time. Taiwan reports to ICCAT show that in the overall Atlantic that albacore is the major species taken, but that the combination of bigeye and yellowfin in recent years is often larger than the albacore catch. ICCAT, *Statistical Bulletin*, various years. Anecdotal reports from Nichirei Carib on St. Maarten landings suggest that in 1991, yellowfin transhipments exceeded those of albacore. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56.
261. Komproe, *op. cit.*, November 13, 2000.
262. The ICCAT SCRS prepared a stock assessment for blue marlin in 2000. The entries for the Netherlands Antilles were 0 for 1997-99. This may mean that no data was available, although the previous annual entries were shaded (except for 1991) meaning that they were estimates. There was no entry at all for Aruba. ICCAT-SCRS,

"2000 Blue marlin--executive summary," ICCAT document DOC #03-B, October 19, 2000.
263. Van Buurt, *op. cit.*, April 25, 2001.
264. Creutzberg, "Welcome aboard!" *op. cit.* and Pichardo, *op. cit.*, March 37, 2001.
265. Pichardo, *op. cit.*, April 10, 2001.
266. Van Buurt, *op. cit.*, April 25, 2001.
267. On Curaçao only about 12 of the larger boats actually report catches. Fishery officials also collect some data at the landing sites. Van Buurt, *op. cit.*, July 23, 2001.
268. Van Buurt, *op. cit.*, April 25, 2001.
269. Van Buurt, *op. cit.*, July 23, 2001.
270. Pichardo, *op. cit.*, March 27, 2001.
271. Pichardo, *op. cit.*, April 10, 2001.
272. Van Buurt, *op. cit.*, April 4, 2001.
273. Van Buurt, *op. cit.*, April 4, 2001.
274. Juhl, *op. cit.*, March 25, 1988.
275. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56.
276. While no actual Taiwan data is available from St. Maarten, Taiwan did publish data on overall transhipments through 1994 (appendix C1). We also have a species breakdown of transshipments through Port-of-Spain, Trinidad in 1993 (appendix C2). While the billfish composition of Trinidad transhipments will not be identical to St. Maarten transhipments, the authors believe that they will be similar, especially as the Taiwan vessels using both transhipment facilities were targeting the same species (tuna) on some of the same grounds (tropical Atlantic). Thus the Taiwan longliners using St. Maarten probably transhipped about 80 t of billfish (appendix C3).
277. Roullot, "Report on mission ...," *op. cit.*, pp. 7 and 10.
278. Van Buurt, *op. cit.*, April 5, 2001.
279. Van Buurt, *op. cit.*, April 25, 2001 and Debrot, *op. cit*, August 9, 2001.
280. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001 and Debrot, *op. cit.*, August 9, 2001. This is discussed above in "XII. Markets".
281. Pichardo. *op. cit.*, April 10, 2001.
282. This is only a rough estimate based on fins as about 1 percent of live weight. Thus the 15.6 t of fins (appendix C2b) would be about over 1,600 t of shark live weight that was transhipped through Port-of-Spain, Trinidad. The Taiwan longliners also probably transhipped about 66 t of shark (appendix C2b), the live weight of which would exceed 100 tons. This would mean a total of 1,700 t when added to the live weight of the fins. There were also probably some sharks taken that were not finned. Given this and the low conversion factor used, 1,700 t is a very conservative estimate of the possible quantity of shark involved. The authors note that Taiwan sources suggest much higher levels of transhipments through Port-of-Spain (appendix C1). If the Taiwan reports are correct, shark landings/transshipments could be much higher, perhaps closer to 7,000 tons (appendix C5a).
283. Hsu Ming Hong, China Sea (Montevideo), personal communications, July 16, 1996.
284. The authors have no data from the Taiwan fleet, but the Japanese report that large numbers of sharks are alive, most quite vigorous, when the catch is harvested. T. Matsumoto and N. Miyabe, "Report of the 1999 observer program for Japanese tuna longline fishery in the Atlantic Ocean, *Collective Volume of Scientific Papers* (SCRS/99-138) (table 6). The authors believe that the same will be true for the Taiwan fleet.
285. John Hoey, NMFS, personal communications, April 11, 2001.
286. Van Buurt, *op. cit.*, April 27, 2001.
287. B. de Boer, D. Hoogerwerf, I. Kristensen, J. Post, F. Creutzberg, and D. Poppe, "Antillean fish guide," (English edition), *Stinapa*, No. 7 (Caribbean Marine Biological Institute: Curaçao, 1973), 111p. Some work has been done on these species. R.P. van Dam and C.E. Diez, "Caribbean hawksbill turtle morphometrics," *op. cit.*, pp. 145-155.
288. Fisheries Ordinance of 1993.
289. Caballero, *op. cit.*, June 5, 2001.
290. Van Buurt, *op. cit*, May 29, 2001.
291. T. Barnes, K.L. Eckert, and J. Sybesma, "WIDECAST sea turtle recovery action plan for Aruba," *CEP Technical Report*, No. 25 (UNEP Caribbean Environmental Programme: Kingston, Jamaica, 1993), 58p and Debrot, *op. cit.*, May 10, 2001.
292. T. van Eijck, "Progress for sea turtles: Sea Turtle Club Bonaire," *Marine Turtle Newsletter*, no. 75, October 1996, pp. 23-24.

293. Roullot, "Report on mission ...," *op. cit.*, p. 11.
294. Van Eijck, "Progress ...," *op. cit.*, pp. 23-24.
295. G. Van Buurt, *De Schildpadden van Curaçao en Bonaire* (Netherlands: J.M. van Buurt Boekproducties, 1995).
296. Van Eijck, "Progress ...," *op. cit.*, pp. 23-24.
297. Debrot, *op. cit.*, May 10, 2001.
298. Jeffrey Sybesma and Paul C. Hoetjes, "First record of the olive Ridley and of nesting by loggerhead turtle in Curaçao," *Caribbean Journal of Science*, Vol. 28, No. 1-2, pp. 103-104.
299. Van Buurt, *De Schildpadden ..., op. cit.*
300. A.O. Debrot and J.J. Pors, "Sea turtle nesting activity on northeast coast beaches of Curaçao," *Caribbean Journal of Science*, Vol. 31, 1995, pp. 333-338.
301. Debrot, *op. cit.*, May 10, 2001.
302. Dave O'Brien, internet posting, July 3, 1999 and Peter Nacken, "Trip report M/V *Caribbean Explorer*, cruising from St. Maarten to Statia and Saba. May 1-8 1999," internet site accessed April 2, 2001: http://www.peternacken.com/dive/page20.htm
303. U.S. Department of State, "New oil refinery in St. Eustatius," message number 86686, March 19, 1992.
304. Larsen, "Fishing Dutch ...," *op. cit.*
305. Caballero, *op. cit.*, June 5, 2001.
306. Van Buurt, *op. cit.*, April 25, 2001.
307. Debrot, *op. cit.*, August 9, 2001.
308. Anonymous Curaçao source, personal communications, March 15, 2001.
309. Van Buurt, *op. cit.*, April 25, 2001.
310. Anonymous fisherman, personal communications, April 3, 2001.
311. The Venezuelan results are discussed in some detail. Curaçao officials note that in the 1960s, Venezuelans fishermen were still largely harvesting turtles and there would have been no reason to hide turtle bycatches. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.
312. NMFS, unpublished data reported in pelagic logbooks and maintained by the Southeast Fisheries Science Center.
313. A.O. Debrot, J.A. de Meyer, and P.J.E. Dezentjé, "Additional records and a review of the cetacean fauna of the Leeward Dutch Antilles," *Caribbean Journal of Science*, Vol. 34, 1998, pp. 204-210.
314. A.O. Debrot and N.B. Barros, "Notes on a Gervais' beaked whale, *Mesoplodon europaeus*, and a dwarf sperm whale, *Kogia simus*, stranded in Curaçao, Netherlands Antilles," *Marine Mammal Science*, Vol. 8, No. 2, 1992, pp. 172-178.
315. Phillip E. Graf, "White-bellied whales and other tales," *Habitat Curaçao--The Freedom Journal*, March 1999.
316. Pichardo, *op. cit.*, March 27, 2001.
317. Larsen, "Fishing Dutch ...," *op. cit.*
318. P.T. Stevick, C.A. Carlson, and K.C. Balcomb, "A note on migratory destinations of humpback whales from the eastern Caribbean," *Journal of Cetacean Research and Management*, Vol. 1, no. 3, December 1999, pp. 251-254.
319. Theriault, *op. cit.*, April 27, 2001.
320. U.S. Consulate General, Curaçao, "Whaling activities of fishing vessel Tonna," message number 670, September 13, 1970.
321. Ruud van Halewyn and Robert L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), "Status and conservation of the world's seabirds," *ICBP Technical Publication*, No. 2 (ICBP: Cambridge, 1984), pp. 175-176.
322. F.C. Schaffner, R.L. Norton, and J. Taylor, "Range extension of Cayenne terns on the Puerto Rico Bank," *Wilson Bulletin*, Vol. 98, No. 2, 1986, pp. 317-318 and K.H. Voous, "Northern gulls in Aruba, Netherlands Antilles," *Ardea* Vol. 64, No. 1-2, 1977, pp. 80-82.
323. Larsen, "Fishing Dutch ...," *op. cit.*
324. Kim Rivera, NMFS, personal communications, April 27, 2001.
325. Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," February 2001.

SECTION XVI. (International)

326. José Barañano, ICCAT Commission Chairman, letter to Netherlands Antilles requesting information on swordfish catches, 2001.
327. De Bot, *op. cit.*, March 24, 1998.

328. Bernhard Komproe, presentation at ICCAT annual meeting, November 13, 2000.
329. The NA Cabinet in 2000 did apparently, at the urging of Maurice Adraans who at the time was the Minister for SINA, vote to join ICCAT. The Spanish companies which register tuna seiners under the NA flag were reportedly encouraging SINA to seek ICCAT membership for the NA so they could get access to a NA tuna quota. The Cabinet decision was reportedly made in the absence of the Mrs. S. Römer, the Minister of Economic Affairs (DEPEZ). When Mrs. Römer returned that was a contentious debate within the Cabinet and the decision to join ICCAT was reversed.
330. Komproe, *op. cit.*, November 13, 2000.
331. Some local observers charge privately that SINA and the Spanish owners have been trying to "create trouble" with ICCAT to force the NA to join ICCAT, reasoning that the NA would then get a tuna quota that they could use.
332. VanBuurt, *op. cit.*, July 23, 2001.
333. ICCAT, "ICCAT Enhanced ...," *op. cit.*, p. 4.
334. When the Colombian and Venezuelan chapters to this book were compiled the authors has not yet processed the ICCAT foreign catch data.
335. Pichardo, *op. cit.*, March 27, 2001.
336. For details see the Colombian chapter of this report.
337. U.S. Consulate General, Hamilton, "Japanese tuna fishing off Bermuda," message number 575, October 30, 1979.
338. See the Bermuda chapter of this report for more details.
339. Y. Uozumi, "Preliminary analysis on the distribution of sailfish and longbill spearfish in the Atlantic Ocean in 1993 based on logbook data," *ICCAT Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 29. The Japanese have reported some swordfish catches in Colombian waters to the west of the Netherlands Antilles. Some fishing may have been conducted off Aruba, but not in Netherlands Antilles waters (Bonaire and Curaçao). ICCAT, "1994 SWO background document: Figures," *ICCAT Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 91.
340. U.S. Consulate General, Hamilton, "Japanese tuna fishing off Bermuda," message number 575, October 30, 1979.
341. Korean Fisheries Administration, personal communications, July 27, 1981.
342. Reviewers have asked the authors why we even mention an erronious report. We do this because to give a flavor for the local discussions if the fishery, but more important so that any one working in the Netherlands Antilles or further researching the subject will not be confused if they receive a similar account.
343. See for example ICCAT, "1994 SWO background document: Figures," *op. cit.*, p. 91.
344. Van Buurt, *op. cit.*, April 3, 2001.
345. U.S. Consulate General, Hamilton, "Japanese tuna fishing off Bermuda," message number 575, October 30, 1979.
346. Details on Taiwan swordfish catches in the northeastern Caribbean see the Anguillian chapter of this report.
347. Pichardo, *op. cit.*, March 27, 2001.
348. Van Buurt, *op. cit.*, April 25, 2001.
349. Inkel, *op. cit.*, August 3, 1999.
350. VanBuurt, *op. cit.*, July 23, 2001.
351. Theriault, *op. cit.*, April 27, 2001.
352. For details see the Bermuda chapter of this book.
353. See the Bermuda chapter of this report for more details.
354. For details see the Trinidadian chapter of this report.
355. Jason Kuo, Marketing Manager, Kwo-Jeng Marine Services, personal communications, September 17, 1999.
356. Details on the U.S. swordfish fishery are available in Karyl K. Brewster-Geisz, "United States," *World Swordfish Fisheries*, Vol. V. (NMFS: Silver Spring, Maryland), pp. 63-102.
357. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1996," *NOAA Technical Memorandum* (NMFS-SEFSC-407), January 1998, p. 3 and Jean Cramer, "Large pelagic logbook newsletter - 1995," *NOAA Technical Memorandum* NMFS-SEFSC-394, November, 1996, p. 3.
358. See for example: Roullot, "Report on mission ...," *op. cit.* and Giudicelli, "Programme for fisheries development ...," *op. cit.*
359. Van Buurt, *op. cit.*, September 10, 1985.
360. Van Buurt, *op. cit.*, April 25, 2001.
361. *Royal Decree*, December 25, 1977.
362. Van Buurt. *op. cit.*, April 25, 2001.

SECTION XVII. (Enforcement)

363. Dutch Defence Minister Frank de Grave in 1998 mentioned 223 arrests for illegal fishing, but did not specify the time period. "Antilles still owe Holland 30 million for Coast Guard," *The Daily Herald Newspaper Online,* 1998: internet posting: http"//www.thedailyherald.com/news/daily/c165/grave165.html
364. Van Buurt, *op. cit.*, April 25, 2001.
365. Proplan Consulting Group, *Project Dossier Upgrading Visserij Saba* (Proplan: Curaçao, 1992) and E.H. Meesters, H. Nijkamp, and L. Blijvoet, *Toward Sustainable Development of the Saba Bank* (Aide Environment: Amsterdam, 1996), 58p.
366. Van Buurt, "Fisheries situation on Saba ...," *op. cit.*, p. 4.
367. U.S. Caribbean Fisheries Management Council, "Council Memo," October 1982.
368. Mike Dallarosa, NMFS, personal communications, February 24, 2000.
369. Van Buurt, "Fisheries situation on Saba ...," *op. cit.*, p. 4.
370. U.S. Consulate General, Curaçao, "The Venezuelan factor in the Dutch Caribbean," message number 218, February 27, 1989.
371. Pichardo, *op. cit.*, March 27, 2001.
372. Van Buurt, *op. cit.*, April 4, 2001.
373. Van Buurt, *op. cit.*, April 27, 2001.
374. Rinaldo, *op. cit.*, May 16, 2001.
375. U.S. Consulate General, Curaçao, "Improvement of Caribbean oil spill response capability," message number 928, December 13, 1994.
376. Mike Dallarosa, NMFS, personal communications, February 24, 2000.

Appendices

Series A: Fleet
Series B: Catch
Series C: Transshipments
Series D: Trade
Series E: Bycatch
Series F: Glossary

Appendix A1a1.--Curaçao. Fishing fleet by size category, 1979-94

Size category	Year							
	1979	1981	1983	1987	1988	1990	1993	1994
Length in meters				Number of boats				
Over 9 m	32	37	37	39	51	78	89	89
7-9 m	45	48	47	59	60	66	69	73
5-7 m	52	58	61	63	71	77	77	73
Total	129	143	145	165	182	221	235	255

Source: Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," July 2001, figure 1.

Appendix A1a2.--Curaçao. Fishing fleet operations by landings site ("visserhaven"), 1994

Visserhaven	Fishing boats*
	Number
Baai Macola	16
Bati PaZa	4
Caracasbaai	30
Caracasbaai Visserhaven	80
Cura Buricu	8
Playa Canoa	2
Piscaderabaai	17
Rif (KAE)	14
Santa Martha binnenbaai	11
Sint Michiel (Boca)	4
Wespunt	2
Variable/unknown	67
Total	255

* Fishing vessels 5 m or more
Source: Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," July 2001.

Appendix A1b.--Netherlands Antilles. Origin of Netherlands Antilles fishing vessels

Source/ Island/country	Fishing boats Number*	Proportion
		Percent
Antillian construction		
Curaçao	228	91
Bonaire	5	2
Imports		
United States	8	3
Netherlands	5	2
Venezuela	5	2
Others	2	1
Total**	251	100

* Approximation based on proportion.
** Totals may not agree due to rounding.
Source: Gerard Van Buurt, personal communications, April 25, 2001.

Appendix A2a.--Netherlands Antilles. Tuna purse seine fleet

Period/ name	Status
1970s-early 80s**	
Atlantis	Undergoing repairs in 1981
Bold Fleet	Active in 1978-80*
Bold Phoenician	Active in 1978-80*
(El) Caribe	Active in 1978-80*
Gold Coast	Active in 1978-81*
Mariner	Active in 1978-79*
South Seas	Active in 1978-80*
South Wind	Active in 1978-80*
1999-2001	
Unidentified***	Eight Spanish-owned seiners flagged

Note: These purse seiners have been largely or entirely deployed in the Eastern Pacific.
* These are dates the authors can confirm, these vessels may have been active other years as well. Seiners were first reported operating from the NA in 1973 (appendix A1b).
** Several of these vessels were sold to Mexican owners in 1981. The authors do not have a list.
*** These authors do not have a list of these vessels. They were operating under the Antillian flag in 2001, but the authors are not sure when they were first registered, perhaps 1999.
Sources: Various

Appendix A2b.--Netherlands Antilles. Tuna purse seine fleet, 1970-2000

Year	Vessels	Carrying capacity	Operations
	Number	Short tons	
1970	-	-	
1971	-	-	
1972	-	-	
1973	2	2,700	Pacific
1974	2	2,436	Pacific
1975	2	2,436	Pacific
1976	2	2,468	Pacific
1977	4	4,560	Pacific
1978	8	9,333	Pacific
1979	8	9,338	Pacific
1980	3	3,711	Pacific
1981-98	-	-	
1999	8	NA	Atlantic
2000	8	NA	Atlantic

NA - Not available
Source: IATTC, *Annual Report*, various years (1970-98) and other sources.

Appendix A2c.--Netherlands Antilles. Tuna longline fleet, 1978-2001

Name	Owner	Length	Hull	Built	Status#
		Meters			
Unknown	Unknown	16			Planned in 1978 for fishery development
Unknown	Unknown	14			Dutch aid program (1985)
Driekiel	Blue Caribbean**	12	GRP		Operated in 1999##
Bigeye	Blue Caribbean	21	Steel	US	Acquired in late 2000
Make My Day	Diaz/Vispaljs	15E	Wood		Began operations in 2000
Raven	Unknown	18E			Operated from Bonaire, in dry dock (2001)

E- Estimated
* Few details are available, but the vessels were probably built in the Netherlands.
** Leased from a Dutch company.
# These vessels all operated from Curaçao except as noted.
Transferred to St. Maarten, but was not used as a longliner there.
Sources: Various

Appendix A3.--Taiwan. Longliners transhipping through St. Maarten, 2000

Current vessel name	Alternative name#	Built		Size		Holds	Engine	Speed	Registration
		Country	Year	Capacity	Length				
				GRT	Meters	Number	HP	Knots/hour	
Chen Yuan 3									
Chien Ching 212	Chien Chin 112	Taiwan	1985	437			1,200	11	Honduras
Chien Hisen 112		Taiwan	1985	441	48.6	NA	1,000	NA	Taiwan
Chien Jui 102		Taiwan	1985	441	48.6	NA	1,000	NA	Taiwan
Chien Ta 322	Dah Chien 32	Taiwan							No declared flag
Chien Tong 202									
Chien Tsac 32	Chien Tsao	Taiwan							Taiwan
Chien Yu 3	Chien Yu 7	Taiwan	1986	713			1,100	11	Honduras
Chimana Chica									Venezuela##
Chimana Este									Venezuela##
Chimana Grande									Venezuela
Fong Ya 11	Fong Ta 11	Taiwan			32.6				Taiwan
Guanta 17									Venezuela
Guanta 19									
Hung Yih 3	Hung Yu 212	Taiwan	1997	550	48.7		1,400	12	Equatorial Guiana
Hung Yih 2/2*									
Hwa Chih 212		Taiwan	1997	470			1,200	11	Belize
Hwa Ching 202				470	53.0				Belize
Hwa Shan 16	Hwa Hsing	Japan	1987	181					Honduras
Hwa Shyuan 16	Hwa Hsing 16	Japan							Honduras
Hwa Tsan 202									
Kao Fong 6	Kao Fong 1	Taiwan	1997	550	48.7		1,400	12	Belize
Kao Fong 113									
Shiuh Sheng 1									

Transliterating Chinese characters into English is more of an art form than an exact science. Thus some of these vessels may appear under a different English name. It is also possible that the names of some of these vessels have been changed.
The authors can not confirm that these vessels are registered in Venezuela, but they are believed that they are owned by a Venezuelan company.
* This may be a typo from the source. It may be Hung Yih 212.
Date: The vessel list is undated, but looks to be about 2000
Note: Many of these vessels do not appear on available vessel lists. As they are mostly older vessels, this is surprising. It is to be expected that small Caribbean island longliners often do not appear on vessel data bases. It is unusual for large commercial vessels not to appear. The authors are unsure why so many of the large, commercial longliners transshipping through St. Maarten are not appearing in available data bases.
Source: Great Bay Port, "St. Maarten harbour cargo facilities," internet site accessed April 9, 2001: http://www.greatbay_port_cargo.htm and the Office of Naval Intelligence, personal communications, May 4, 2001.

Appendix B1a.--Netherlands Antilles. Fisheries catch, 1980-98

Year	Catch		Total
	Neth. Ant*	Aruba#	
	Metric tons		
1980	1,090F	770F	1,860F
1981	990F	770F	1,760F
1982	1,030F	770F	1,800F
1983	1,030	770F	1,800F
1984	1,030F	770F	1,800F
1985	1,030F	770	1,800F
1986	1,060F	780F	1,840F
1987	1,109F	780F	1,889F
1988	1,210F	790F	2,000F
1989	1,210F	480F**	1,690F
1990	1,210F	420F	1,630F
1991	1,110F	350F	1,460F
1992	1,155F	300	1,455F
1993	1,205F	250	1,455F
1994	1,105F	250	1,355F
1995	1,006F	130	1,136F
1996	996F	150	1,146
1997	1,100F	205	1,305
1998	1,020F	182	1,202

* The great bulk of the Netherlands Antilles catch is taken by fishermen on Curaçao. One source estimated over 80 percent is taken by the Curaçao fishermen.
** FAO once estimated 1989 catches as 800 t, but subsequently reduced the estimates to only 480 tons. Earlier estimates may have been reduced as well.
# Available catch estimates show a major decline in 1989. Some observers believe, however that the historic catch estimates of 790 t were much to high. Even catches of about 500 t seem high. Thus the apparent decline appears to be largely a statistical correction. Gerard Van Buurt, Curaçao Fisheries Section, personal communications, April 25, 2001. Historic accounts from the 1960s, foe example, estimate the Aruban fisheries catch at about 300 tons. Jacques S. "The sea fisheries of the Netherlands Antilles," *Collected Papers*, No. 17 (Caribbean Marine Biological Institute: Trinidad, 1960), p 14.
F - FAO estimate
Source: FAO, *Yearbook of Fishery Statistics*, (FAO: Rome, various years).

Appendix B1b.--Dutch Caribbean islands. Estimated fisheries catch, 1984

Island	Catch
	Metric tons
Aruba	770
Bonaire	80
Curaçao	850
Saba	30
St. Maarten	-
St. Eustatius	30
Total	1,760

Source: G. Van Buurt, Head, Curaçao Fisheries Section, personal communications, September 10, 1985.

Appendix B2a1.--Netherlands Antilles. Fisheries catch, 1993-98

Species	Year					
	1993	1994	1995	1996	1997	1998
	Metric tons					
Freshwater	Negl	Negl	Negl	Negl	Negl	Negl
Marine						
Billfish						
Sailfish	15F	15F	15F	15F	20F	20F
Blue marlin	40F	40F	40F	40F	45F	50F
Tunas						
Blackfin	65F	60F	50F	45F	50F	50F
Skipjack	45F	40F	35F	30F	35F	40F
Yellowfin	170F	155F	140F	130F	140F	150F
Wahoo	270F	250F	230F	230F	250F	200F
Other	595F	540F	490F	500F	550F	500F
Conch	5F	5F	6F	6F	10F	10F
Total	1,205F	1,105F	1,106F	996F	1,100F	1,020F

* Includes jobfishes and other related species
Source: FAO, *Yearbook of Fishery Statistics*, various years.

Appendix B2a2.--Curaçao. Species composition of traditional fishery

Species	Proportion
	Percentage
Billfish*	5
Dorado	15
Rainbow runner	10-15
Reeffish	10-15
Tunas**	25
Wahoo	20
Other	5

* Blue and white marlin and sailfish
** Yellowfin, blackfin, skipjack,bigeye, and little
Source: Curaçao Fisheries Section, "Visserijbeleidsplan Eilandgebied Curaçao," July 2001.

Appendix B2b.--Aruba. Fisheries catch, 1993-98

Species	Year					
	1993	1994	1995	1996	1997	1998
	Metric tons					
Freshwater	Negl	Negl	Negl	Negl	Negl	Negl
Marine						
Grouper	NA	NA	20	20	25	22
Snappers*	NA	NA	50	60	60	50
Wahoo	80	125	40	50	65	70
Sailfish	Negl	Negl	Negl	Negl	Negl	Negl
Other	170	125	20	20	55	40
Total	250	250	130	150	205	182

* Includes jobfishes and other related species
Source: FAO, *Yearbook of Fishery Statistics*, various years.

Appendix B3a.--Netherlands Antilles. Swordfish catch, transhipments, and trade, 1980-2000

Year	Catch			U.S.	Imports**		
	FAO	ICCAT	NA	Landings*	U.S.	Japan	E.U.
	Metric tons (live-weight equivalents)						
1980	-			NA	-		
1981	-			NA	23.0		
1982	-			NA	59.9		
1983	-			NA	-		
1984	-			-	0.6		
1985	-			-	11.6		
1986	-			-	13.7		
1987	-	NA		-	8.3		
1988	-	NA		8.7+	38.3		
1989	-	NA		-	9.4		
1990	-	NA		5.6+	12.1	3.0E	NA
1991	-	NA		-	-	-	227.0
1992	-	NA		-	2.9	-	184.0
1993	-	NA		-	-	-	69.0
1994	-	NA		-	-		84.0
1995	-	NA		-	-		
1996	-	NA		-	17.3		
1997	-	NA		-	-		
1998		NA		-	-		
1999			0.4		-		
2000			0.3		-		

* Live-weight equivalents of U.S. landings in the Netherlands Antilles (Aruba).
** Based on foreign import trends. This is a minimum estimate as there was also probably some domestic consumption.
+ At Aruba
Note: Foreign imports (appendix D1) and landings (appendix B3b) were converted to live weight based on a conversion factor of 1.4.
NA - Not available
Source: FAO, *Yearbook of Fishery Statistics*, various years; ICCAT, *Statistical Yearbook*, various years; Gerard Gerard Van Buurt, NA Fisheries Section, personal communications, April 18, 2001; foreign trade data as noted above, and NMFS Southeast Fisheries Science Center.

Appendix B3b.--United States. Swordfish landings in the Netherlands Antilles (Aruba), 1984-98

Year	Landings
	Metric tons*
1984	-
1985	-
1986	-
1987	-
1988	8.7
1989	-
1990	5.6
1991	-
1992	-
1993	-
1994	-
1995	-
1996	-
1997	-
1998	-

* Product, primarily trunk weight
Source: Southeast Fisheries Science Center, National Marine Fisheries Service.

Appendix B3c.--Netherlands Antilles. Swordfish exports by vessel, 1999-2000

Vessel	Year	Trips	Exports
		Number	Kilograms*
Bigeye	2000	3	314.8
Driekiel	1999	2	264.0
	2000	-	-
Make My Day	2000	-	-
Raven	1999	-	-
	2000	-	-

* The export data is expressed in product or dressed weight which is about 70 percent of the live weight.
Note: While there was no swordfish exports from two of the NA longliners, they may have taken small amounts which they marketed domestically. Thus actual catches may be slightly larger than suggested by the export data.
Source: Netherlands Antilles export data provided by Gerard Van Buurt, personal communications, April 18, 2001.

Appendix B4c.--Netherlands Antilles. Longline results, January through April 2001

Trip	Sets	Results	Comments
1	1	27 fish*	20 swordfish**
2	5	120 fish*	
3	3	115 fish*	
4	3	55 fish*	
5	NA	0 fish*	Significant increase in water temperature#
6	NA	0 fish*	

Note: Fishing results aboard the *Bigeye*
* Swordfish and tuna
** In the other trips the catch composition was about half swordfish and half tuna.
# Water temperatures of about 79.6°F were noted on trips 1-4. The water temperature in early April dropped to 81.3°F and for the last half of April has been very stable at 81.3°F. The captain believes that this may have caused the catches to plummet, but cannot be sure.
Source: Craig Theriault, Blue Caribbean, personal communications, April 27, 2001.

Appendix B4a.--Netherlands Antilles. Billfish catch, 1963-92

Year	Blue marlin	White marlin	Sailfish
		Metric tons	
1963	-	-	-
1964	-	-	-
1965	-	-	-
1966	-	-	-
1967	-	-	-
1968	-	-	-
1969	-	-	-
1970	-	-	28*
1971	-	-	28
1972	-	-	28
1973	-	-	28
1974	-	-	28
1975	-	-	28
1976	-	-	28
1977	-	-	28
1978	50*	-	21
1979	50	-	21
1980	50	-	21
1981	50	-	21
1982	50	-	21
1983	50	-	21
1984	50	-	21
1985	50	-	10
1986	50	-	10
1987	50	-	10
1988	50	-	10
1989	50	-	10
1990	50	-	10
1991	40	-	10
1992	40	-	10

* Catches are not believed to have been initiated in these years, but rather this was when the estimation of the catches began.
Source: ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), pp. 254-258.

Appendix B4b1.--Netherlands Antilles. Billfish catches, 1970-79

Species	Year									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
					Metric tons					
Marlin										
Blue	-	-	-	-	-	-	-	-	-	-
White	-	-	-	-	-	-	-	-	-	-
Sailfish	28	28	28	28	28	28	28	28	21	21
Total	28	28	28	28	28	28	28	28	28	28

Note: Other data bases (appendix B4a) report substantial blue marlin catches.
Source: ICCAT, *ICCAT Report*, 1987, Part II, (ICCAT: Madrid, Spain, 1988), pp. 184-186.

Appendix B4b2.--Netherlands Antilles. Billfish catches, 1980-89

Species	Year									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Metric tons									
Marlin										
Blue	-	-	-	-	-	-	-	50F*	50F	50F
White	-	-	-	-	-	-	-	-	-	-
Sailfish	21	21	21	21	21	10	10	10F	10F	10F
Subtotal										
Total	21	21	21	21	21	10	10	60	60	60

Note: Other data bases (appendix B4a) report substantial blue marlin catches throughout the 1980s.
F - FAO data
* This does not represent a major increase in catches, but more likely more accurate catch estimates. Estimates going back to 1978 are available in appendix B4a.
Source: ICCAT, *ICCAT Report*, 1987, Part II, (ICCAT: Madrid, Spain, 1988), pp. 184-186 and ICCAT, *Statistical Bulletin*, 1987 (ICCAT: Madrid, 1998), pp. 208-212

Appendix B4b3.--Dutch Caribbean. Billfish catches, 1990-97

Species	Year								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Metric tons								
Aruba									
Marlin									
Blue	-	-	-	-	-	-	-	-	-
White	-	-	-	-	-	-	-	-	-
Sailfish*	13F	9F	5F	10E	10E	10E	10E	NA	NA
Subtotal	13	9	5	10	10	10	10	NA	NA
Netherlands Antilles									
Marlin									
Blue	50F	40F	40F	40E	40E	40E	40E	45F	50F
White**	-	-	-	-	-	-	-	-	-
Sailfish	10F	10F	10F	15F	15F	15F	15F	20F	20F
Subtotal	60	50	50	55	55	55	55	65F	70F
Total	73	59	55	65	65	65	65	NA	NA

Note: The SCRS prepared a stock assessment for blue marlin in 2000. The entries for the Netherlands Antilles were 0 for 1997-99. This may mean that no data was available, although the previous annual entries were shaded (except for 1991) meaning that they were estimates. There was no entry at all for Aruba. ICCAT-SCRS, "2000 Blue marlin--executive summary," ICCAT document DOC #03-B, October 19, 2000 and ICCAT-SCRS, "2000 White marlin--executive summary," ICCAT document DOC #04-B, October 19, 2000. A SCRS sailfish population estimate has not been prepared since 1995, but one is scheduled for 2001. Arietta Venizelos, NMFS, personal communications, April 18, 2001.
E - Estimate by SCRS or SCRS Working Group. Includes estimates by national scientists or by the secretariat, which have been reviewed and approved by the SCRS. Note that this is the standard ICCAT footnote, just what the specific source of the Netherlands Antilles data is unknown.
F - FAO data
* FAO enters the Aruban sailfish catch as negligible.
** While ICCAT does not report a white marlin catch, Antillian officials reports that there is a white marlin catch which exceeds that od sailfish.
Source: ICCAT, *Statistical Bulletin*, 1987 (ICCAT: Madrid, 1998), pp. 208-212 (1990-96 data) and FAO, *Yearbook of Fishery Statistics*, 1998 (1997-98 data).

Appendix B5a.--Wider Caribbean. Foreign swordfish catches in ICCAT area 1065 by country and quarter, 1959-97

Country	Year	Quarter 1	2	3	4	Total
		Metric tons				
Cuba	No swordfish catches reported					
Japan	1957			0.3		0.3
	1958			0.6		0.6
	1959		0.1		0.3	0.4
	1960	0.1		0.1	0.1	0.3
	1961			0.1		0.1
	1962		0.6			0.6
	1963	0.5	0.1	0.7	4.1	5.4
	1964		2.0	0.2	1.0	3.2
	1965		0.8	1.0	0.2	2.0
	1966	0.3		12.5	0.9	13.7
	1968			1.3		1.3
	1969			0.1	2.7	2.8
	1970		0.5			0.5
	1971	0.1				0.1
	1974				1.3	1.3
	1975	0.2		0.4		0.6
	1976		0.1			0.1
	1977			0.6		0.6
Korea	1978			6.4	12.6	19.0
	1979		1.7	3.6	2.7	8.0
	1980		0.5			0.5
	1981		0.2	0.2	0.3	0.7
	1985			1.3	0.3	1.6
Spain	No swordfish catches reported					
Taiwan	1968	0.2		0.2	1.5	1.9
	1969	0.9		0.2		1.1
	1970			0.5		0.5
	1971	0.1				0.1
	1974			0.9		0.9
	1975			1.4	0.6	2.0
	1976			1.4	1.4	2.8
	1977				0.6	0.6
	1980			1.3		1.3
	1983	0.2				0.2
	1985			0.2		0.2
	1996			0.2	3.9	4.1
United States	U.S. fishing data unavailable**					

* ICCAT square are 5° degree squares of latitude and longitude. The first two numbers are the latitude and the second two numbers are the longitude. This represents the southeastern corner of the 5° square for catches in quadrant 4, northwest Atlantic.

** The authors encountered apparent statistical problems with the U.S. data on the ICCAT web site. Apparently ICCAT is in the process of recalculating the 1° square data by 5° squares. As a result this data was not added to this appendix.

Source: ICCAT: http://www.iccat/es/Stats.html, retrieved July 3, 2000

Appendix B5b.--Wider Caribbean. Foreign swordfish catches in ICCAT area 1070 by country and quarter, 1959-97

Country	Year	Quarter 1	2	3	4	Total
		Metric tons				
Cuba	No swordfish catches reported					
Japan	1962		0.2			0.2
	1963	0.3		2.0	4.1	6.4
	1964	0.2		1.4	0.2	1.8
	1965		0.2	0.2	1.0	1.4
	1966		0.2	6.9	1.2	8.3
	1968	0.5		0.3	0.3	1.1
	1969				0.6	0.6
	1970				1.3	1.3
	1971	0.1		0.9		1.0
	1972			1.2		1.2
	1974		0.5	4.7		5.2
	1975	0.9	0.2	1.1		2.2
	1976		0.1	0.3		0.4
	1977			0.2	0.3	0.5
	1978	0.1				0.1
	1982	0.3		0.6		0.9
	1984	0.7	0.6	3.1	0.7	5.1
	1985	2.4	0.5	0.2	0.5	3.6
	1986		3.7	6.7	0.6	11.0
	1987	0.9	5.8			6.7
	1989		0.1	1.1	0.4	1.6
	1990		1.8		1.1	2.9
	1991			0.2	2.3	2.5
	1992		1.7	9.9	5.4	17.0
	1993		1.6	10.8	5.9	18.3
	1994				1.5	1.5
	1996	2.8	8.2	32.9	2.8	46.7
	1997	0.3	4.5	6.6		11.4
Korea	1977				1.1	1.1
	1978			1.2	7.2	8.4
	1979	0.8		0.4	0.2	1.4
	1985			0.3		0.3
Spain	No swordfish catches reported					
Taiwan	1968				2.3	2.3
	1969				0.2	0.2
	1970			1.2	1.5	2.7
	1972		5.5	0.3	0.3	6.1
	1974			6.5	0.6	7.1
	1975			1.0		1.0
	1976			4.2	6.9	11.1
	1980			2.0		2.0
	1982				0.3	0.3
United States	U.S. fishing data unavailable**					

* ICCAT square are 5° degree squares of latitude and longitude. The first two numbers are the latitude and the second two numbers are the longitude. This represents the southeastern corner of the 5° square for catches in quadrant 4, northwest Atlantic.

** The authors encountered apparent statistical problems with the U.S. data on the ICCAT web site. Apparently ICCAT is in the process of recalculating the 1° square data by 5° squares. As a result this data was not added to this appendix.

Source: ICCAT: http://www.iccat/es/Stats.html, retrieved July 3, 2000

Appendix C1.--Taiwan. Overseas landings/transshipments of Atlantic-caught swordfish, 1989-94

Port	Location	Year					
		1989	1990	1991	1992	1993	1994
		Metric tons					
Shimizu*	Japan	-	-	-	18	17	718***
Cape Town	South Africa	132	399	414	447	28	631
Various	Brazil**	-	-	-	-	210	463
Port-of-Spain	Trinidad	31	190	26	119	190	369
Montevideo	Uruguay	219	72	105	144	99	239
Las Palmas	Canary Islands	49	59	62	12	-	113
St. Maarten	Netherlands Ant.	40	45	50	64	46	59
Unknown		NA	1	-	-	-	-
Other		-	-	-	-	166	464
Other		482	768	656	803	755	3,056

* Landings at Shimizu are probably product transhipped at sea.
** Taiwan longliners landed larger quantities in Japan beginning in 1991, but the vessels operated under joint ventures which is probably why the landings in Brazil were not reported as transshipments. See the Brazilian chapter of this report for details.
*** Substantial landings at Shimizu did not begin until 1994, this may mean that Taiwan Atlantic transhipments at sea did become significant until that year.
Note: Data on transshipping was omitted in the 1995 yearbook.
Source: Taiwan Fisheries Bureau, *Fisheries Yearbook Taiwan Area.*

Appendix C2a.--Trinidad. Transhipping/landing data, 1993

Species	Country			Total
	Taiwan	Canada	Trinidad	
		Metric tons*		
Billfish				
Marlin				
Black@	110.6	-	-	110.6
Blue	114.9	-	-	114.9
Other	-	-	-	-
Sailfish	55.1	-	-	55.1
Spearfish	62.2	-	-	62.2
Swordfish	51.9	3.8	69.4	125.1
Subtotal#	394.7	3.8	69.4	468.0
Sharks				
Blue	58.3	-	-	58.3
Mako	113.4	-	0.2	113.5
Thresher	-	-	-	-
Other	104.2	-	-	104.2
Fins**	64.8	-	-	64.8
Subtotal#	340.7	-	0.2	340.8
Tunas				
Albacore	639.1	-	-	639.1
Bigeye	241.9	0.8	14.8	257.6
Bluefin	-	-	-	-
Skipjack	2.1	-	-	2.1
Yellowfin	141.1	0.5	76.9	218.5
Other	317.3	-	0.8	318.1
Subtotal#	1,341.5	1.3	92.6	1,435.4
Other small pelagics				
Dorado	18.0	-	-	18.0
Kingfish	141.1	-	-	141.1
Yukum##	15.8	-	-	15.8
Unidentified	3.8	-	-	3.8
Subtotal#	178.8	-	-	178.8
Total	2,255.6###	5.2	162.1	2,422.9

@ This is a Pacific species. Taiwan fishermen, who are more experienced in the Pacific, often use it to describe part of their Atlantic billfish catch, even though the species is not taken in the Atlantic.
* Landed weight
** Unidentified species
# Totals may not agree due to rounding
This is a Taiwan species name. The species is unknown to the Trinidadians. One Trinidadian researcher working at NFC report that the Taiwan fishermen sometimes used it as bait. Christine Chan-A.Shing, Fisheries Division, personal communications, March 14, 2000.
The discrepancy with appendix C1 is not fully understood. Part of the difference may be that appendix C1 may be product actually transhipped to Japan. This appendix may include fish sold locally or in other Caribbean ports.
Source: Fisheries Division, Ministry of Agriculture, Land and Marine Resources, "National report of Trinidad and Tobago," SCRS/94/129, *Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 266.

Appendix C2b.--Taiwan. Transhipping/landing data and estimates, 1993

Species	Transhipments through Trinidad	Transhipments through St. Maarten
	Metric tons*	
Billfish		
Marlin		
Black@	110.6	26.5E
Blue	114.9	27.6E
Other	-	-
Sailfish	55.1	13.2E
Spearfish	62.2	14.9E
Swordfish	51.9###	12.5E###
Subtotal#	394.7	94.7E
Sharks		
Blue	58.3	14.0E
Mako	113.4	27.2E
Thresher	-	-
Other	104.2	25.0E
Fins**	64.8	15.6E***
Subtotal#	340.7	81.8E
Tunas		
Albacore	639.1	153.3E
Bigeye	241.9	58.1E
Bluefin	-	-
Skipjack	2.1	0.5E
Yellowfin	141.1	33.9E
Other	317.3	-
Subtotal#	1,341.5	322.0E
Other small pelagics		
Dorado	18.0	4.3E
Kingfish	141.1	33.9E
Yukum##	15.8	3.8E
Unidentified	3.8	0.9E
Subtotal#	178.8	42.9E
Total	2,255.6	541.3E

E - Estimates based on the fact that St Maarten transhipments in 1993 were 24 percent of Trinidad transhipments (appendix C1). While there could and probably were differences between the species composition of the shipments, the fact that the vessels operating from both ports were targeting tuna and fishing some of the same grounds, it is likely that there was some similarity in the species composition. It should be noted that the Taiwan swordfish data here is much lower than that reported by Taiwan in appendix C1. Thus the quantities of the other species could also be understated.
@ This is a Pacific species. Taiwan fishermen, who are more experienced in the Pacific, often use it to describe part of their Atlantic billfish catch, even though the species is not taken in the Atlantic.
* Landed weight
** Unidentified species
*** The live-weight of the sharks fined at sea probably exceeds 1,500 t using a conversion rate of 1 percent.
# Totals may not agree due to rounding
This is a Taiwan species name. The species is unknown to the Trinidadians. One Trinidadian researcher working at NFC report that the Taiwan fishermen sometimes used it as bait. Christine Chan-A.Shing, Fisheries Division, personal communications, March 14, 2000.
The discrepancy with appendix C1 is not fully understood.
Source: Fisheries Division, Ministry of Agriculture, Land and Marine Resources, "National report of Trinidad and Tobago," SCRS/94/129, *Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 266. (Trinidad data).

Appendix C3--Japan and the United States. Tuna imports from the Netherlands Antilles, 1989-2000

Year	Tuna imports	
	Japan	U.S.*
	Metric tons	
1989	-**	4,493
1990	5	67
1991	-	113
1992	-	2
1993	-	-
1994	-	371
1995	-	2,290
1996	16	5,718
1997		7,503
1998		7,957
1999		6,786
2000		5,962

Note: The authors had hoped that Japanese trade data would provide some insight into transshipments through the Netherlands Antilles. The Japanese appear to scrupulously report the flag-of-origin rather than the port of origin. U.S. data, however, appears to be show the port of origin, thus providing a rough idea of transhipment levels.
* Mostly albacore
** No tuna was shipped in 1989, but 55.7 t of frozen shark was shipped
Sources: Japan Tariff Association, *Japan Exports & Imports*, various years and U.S. Bureau of the Census.

Appendix C4a.--Taiwan. Possible swordfish shipments through St. Maarten, 1995-2000

Year	Albacore transhipments#	Possible swordfish bycatch				Taiwan Atlantic swordfish catch+
		Taiwan		Trinidad	St. Maarten	
		10 percent&	30 percent&&	8 percent@	75 percent**	
	Metric tons*			Metric tons		
1995	2,263	226	679	181	1,697	3,365
1996	5,705	571	1,712	456	4,279	3,395
1997	7,497	750	2,624	600	5,623	2,359
1998	7,950	795	2,249	636	5,963	
1999	6,616	662	1,985	529	4,962	
2000	5,829	583	1,749	466	4,372	

Note: The projections in this appendix are highly speculative and can not be used as a definitive statement of Taiwan operations. In the absence of actual Taiwan data, however, these projections do provide a range of possibilities concerning possible Taiwan results.
To the United States
& Taiwan reports to ICCAT that the Atlantic swordfish catch is usually about 5-15 percent of the albacore catch.
&& Taiwan catch data reported to FAO suggests that the billfish catch worldwide is about 30 percent of the albacore catch, although this is highly variable from about 10-40 percent in recent years.
@ There is reason to believe that the Taiwan billfish catch is much higher than that reported by American and some other longline fishermen. Taiwan landings in Trinidad (appendix C2a) of the major billfish species (marlins and sailfish), suggest that they total 45 percent of the albacore catch.
* Product weight
** The Japanese company on St. Maarten indicated in 1991 that billfish was taken in large quantities in the fishery around Bermuda. The catch (presumably meaning the retained catch) composition of Taiwan transhipments on St. Maarten constituted: swordfish (about 11 percent), marlin (30 percent), yellowfin (16 percent), albacore (15 percent), and other species (Bermuda, appendix B7). The vessel involved were primarily operating around Bermuda. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56.
+ The overall swordfish catch reported by Taiwan is provided here as a reference. Note that St. Maarten is the least important of the Taiwan transshipment points (appendix C1).
Source: U.S. Census Bureau (albacore import data); The projections are based on the footnoted sources; and ICCAT, *Statistical Bulletin*, 1997 (Taiwan catch data).

Appendix C4b.--Taiwan. Possible billfish shipments through St. Maarten, 1995-2000

Year	Albacore transhipments#	Possible billfish bycatch					Taiwan Atlantic billfish catch+
		Taiwan		Trinidad		St. Maarten	
		5 percent&	35 percent&&	45 percent@	55 percent@@	200 percent**	
	Metric tons*			Metric tons**			
1995	2,263	113	792	1,018	1,245	4,526	1,678
1996	5,705	285	1,997	2,567	3,138	11,410	1,369
1997	7,497	375	2,624	3,374	4,123	14,994	1,025
1998	7,950	398	2,783	3,578	4,373	15,900	
1999	6,616	331	2,316	2,977	3,639	13,232	
2000	5,829	291	2,040	2,623	3,206	11,658	

Note: The projections in this appendix are highly speculative and can not be used as a definitive statement of Taiwan operations. In the absence of actual Taiwan data, however, these projections do provide a range of possibilities concerning possible Taiwan results.

To the United States

& Taiwan catch reports to ICCAT suggest that billfish is generally 5-8 percent of the albacore catch in the Atlantic.

&& Taiwan catch data reported to FAO suggests that the billfish catch worldwide is about 35 percent of the albacore catch.

@ There is reason to believe that the Taiwan billfish catch is much higher than that reported by American and some other longline fishermen. Taiwan landings in Trinidad (appendix C2a) of the major billfish species (marlins and sailfish), suggest that they total 45 percent of the albacore catch.

@@ This estimate would include the spearfish in the billfish calculation.

* Product weight

** The Japanese company on St. Maarten indicated in 1991 that billfish was taken in large quantities in the fishery around Bermuda. The catch composition (presumably meaning the retained catch) of Taiwan transhipments on St. Maarten constituted: swordfish (about 11 percent), marlin (30 percent), yellowfin (16 percent), albacore (15 percent), and other species (Bermuda, appendix B7). The vessel involved were primarily operating around Bermuda. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56.

+ The overall billfish catch reported by Taiwan is provided here as a reference. Note that St. Maarten is the least important of the Taiwan transshipment points (appendix C1).

Source: U.S. Census Bureau (albacore import data); The projections are based on the footnoted sources; and ICCAT, *Statistical Bulletin*, 1997 (Taiwan catch data).

Appendix C5a.--Taiwan. Possible shark bycatches of St. Maarten-based longliners based on transhipments, 1993

Species/ product	Trinidad data*			Revised St. Maarten transshipments**
	Actual#	St. Maarten##	Live weight###	
			Metric tons	
Blue	58.3	14.0	23.8	71.4
Mako	113.4	27.2	46.2	138.6
Other	104.2	25.0	42.5	127.5
Fins	64.8	15.6	1,560.0	4,680.0
Total	340.7	81.8	1,673.5	5,017.5

Actual weight of dressed landings as reported in source.
Possible St. Maarten shipments based on data indicating the relative importance of transhipment ports. Shipments of swordfish through St. Maarten was about 24 percent of Trinidad shipments in 1993 (appendix C1).
The live-weight of landings is calculated at 1.7 of the dressed weight. Actual Taiwan data is not available. Frozen raw, tail and head off entries vary from 1.33-2.00 in the FAO conversion book. The authors have used a mid-range conversion ratio of 1.7. FAO, "Conversion factors--Landed weight to live weight," *FAO Fisheries Circular* (FAO: Rome, 1992), p. 292. The fins because of the long Taiwan trips are probably mostly dried fins. We have, however, used a conversion rate of 100, midway between the accepted conversion rate for dried and wet fins because there are substantial landings from shorter trips landing fresh tuna and swordfish. The fin conversion rates are based on work done by Jack Casey, Narragansett Laboratory, NMFS Northeast Fisheries Science Center, 1992.
* Taiwan transhipments through Port-of-Spain, Trinidad (appendix C2b) and estimates for St. Maarten based on that data.
** Taiwan sources suggest that more swordfish was being transhipped through Trinidad than reported in appendix C2a. The Taiwan data shows about three times the quantity of swordfish being transshipped as reported in appendix C2a. This means that the quantities of other species such as sharks may have also been reported. Thus we have projected possible shark transhipments/landings based on this ratio.
*** Based on the data in appendix C1, smaller quantities of fish are transhipped through St. Maarten than Trinidad. The shark by catch of the vessels transhipping through the two sites will be different. The two fleets, however, do target many of the same species on some of the same grounds so there will be some similarity. In 1993, St. Maarten shipments were about 25 percent of Trinidad shipments.
Source: Appendix C2a--Fisheries Division, Ministry of Agriculture, Land and Marine Resources, "National report of Trinidad and Tobago," SCRS/94/129, *Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 266 (actual transhipment data). The projections are calculated as noted in the footnotes.

Appendix C5b.--Taiwan. Possible shark bycatch of St. Maarten-based tuna longline operations, 1995-2000

Year	Albacore transhipments#	Possible shark bycatch			
		Trinidad data 1,100 percent*	St. Maarten data**	Japanese data 300 percent***	Taiwan data****
	Metric tons		Metric tons		
1995	2,263	24,893	NA	6,789	NA
1996	5,705	62,755	NA	17,115	NA
1997	7,497	82,467	NA	22,491	NA
1998	7,950	87,450	NA	23,850	NA
1999	6,616	72,776	NA	19,848	NA
2000	5,829	64,119	NA	17,487	NA

NA - Not available

Note: The projections in this appendix are highly speculative and can not be used as a definitive statement of Taiwan operations. In the absence of actual Taiwan data, however, these projections do provide a range of possibilities concerning possible Taiwan results.

Adjustments: Several factors will affect the impact on shark stocks of the longline bycatch, neither of which can be quantified at this time. One of the most important is the number of sharks that are not finned. Standard Taiwan practice, similar to other longline operations, is that if the catch is particularly good, the crew will focus on the most valuable species and sharks may be cut off the line without bringing them aboard. Hsu Ming Hong, China Sea (Montevideo), personal communications, July 16, 1996. An unknown portion of the shark catch is thus released alive without finning. Quite a number of these, especially the blue sharks, are known to survive. John Hoey, NMFS, personal communications, April 11, 2001 and T. Matsumoto and N. Miyabe, "Report of the 1999 observer program for Japanese tuna longline fishery in the Atlantic Ocean, *Collective Volume of Scientific Papers* (SCRS/99-138) (table 6).

To the United States

* This computation is computed based on the live-weight of shark landings reported by Taiwan (appendix C5a) and the proportion reported of shark to albacore. The resulting numbers seem very large and may result from the fact that albacore has been of less importance to the Taiwan vessels operating out of Trinidad than St. Maarten and thus the catch ratios are substantially different.

** The Japanese company on St. Maarten indicated in 1991 that billfish was taken in large quantities in the fishery around Bermuda. The catch (presumably meaning the retained catch) composition of Taiwan transhipments on St. Maarten constituted: swordfish (about 11 percent), marlin (30 percent), yellowfin (16 percent), albacore (15 percent), and other species (Bermuda, appendix B7). The vessel involved were primarily operating around Bermuda. Mr. Hasitani, Assistant General Manager, Nichirei Carib Corporation, as cited in MRAG, "Large pelagic fisheries in the Caribbean: Their role in the economies of U.K. Dependent Territories," report to the Overseas Development Administration, final report, June 1993, p. 56. Mr. Hasitani did not specify sharks specifically. Based on this statement, it is not possible to calculate a shark bycatch.

*** Japan has published reports on the shark bycatch in the Atlantic. Japanese and Taiwan fishing patterns are not identical, but there is some overlap as well as some similarity in fishing gear and methods. One report indicated that shark catches in number of fish was 170 percent of albacore and similar to the total number of tunas. Matsunaga H and H. Nakano, "Report in information of bycatch fishes obtained from observer program for Japanese tuna longline fisheries in the Atlantic Ocean," National Research Institute for Far Seas Fisheries, in press. When calculated for the larger size of the sharks, the quantity of shark could easily be 300 percent for that of albacore.

**** The authors know of no published Taiwan reports on the shark bycatch of their longline fishery. Other NMFS researchers also are not aware of any such published Taiwan reports. Wes Pratt, NMFS Northeast Fisheries Science Center, personal communications, April 11, 2001.

Source: U.S. Census Bureau (albacore import data); The projections are based on the footnoted sources; and ICCAT, *Statistical Bulletin*, 1997 (Taiwan catch data).

Appendix D1.--Netherlands Antilles. Swordfish exports by destination, 1991-99

Destination	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Metric tons										
United States	9	-	2	-	-	-	12	-	-	-***	-***
Japan*	2E	-	-	-	-	-	-	-	-	-	NA
European Union	NA	159	129	48	59	2	-	-	2	-	NA
Others**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	NA	159	131	48	59	2	12	-	-	-	-

NA - Not available
* Estimated swordfish portion of billfish shipments
** Swordfish shipments to other countries are believed to be non-existent or negligible.
*** Unconfirmed reports from the Netherlands Antilles as well as FDA detention reports (Caribbean Overview appendix F2d2) and NMFS COE data (appendix F2a3) suggest that there were small fresh swordfish shipments to the United States in 1999 and 2000. It is unclear why these shipments were not reported in the U.S. import data.
Source: Various

Appendix D2a1a.--United States. Swordfish imports from the Netherlands Antilles, 1975-June 2001

Year	Commodity		Total
	Fresh	Frozen	
	Metric tons		
1975	-	-	-
1976	-	-	-
1977	-	-	-
1978	-	-	-
1979	-	-	-
1980	-	-	-
1981	-	16.1	16.1
1982	-	41.9	41.9
1983	-	-	-
1984	0.3	0.1	0.4
1985	-	8.1	8.1
1986	9.6	-	9.6
1987	5.8	-	5.8
1988	23.8	3.0	26.8
1989	6.6	-	6.6
1990	8.5	-	8.5
1991	-	-	-
1992	2.0	-	2.0
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	12.1	-	12.1
1997	-	-	-
1998	-	-	-
1999	-*	-	-
2000	-*	-	-
2001	-#	-#	-#

* Unconfirmed reports from the Netherlands Antilles as well as FDA detention reports (Caribbean Overview, appendix F2d2) and NMFS COE data (appendix F2a3) suggest that there were small fresh swordfish shipments to the United States in 1999 and 2000. It is unclear why these shipments were not reported in the U.S. import data.
# Through June
Source: U.S. Bureau of the Census

Appendix D2a1b.--United States. Swordfish imports from the Netherlands Antilles, 1975-June, 2001

Year	Commodity		Total
	Fresh	Frozen	
	U.S.$1,000		
1975	-	-	-
1976	-	-	-
1977	-	-	-
1978	-	-	-
1979	-	-	-
1980	-	-	-
1981	-	43	43
1982	-	130	130
1983	-	-	-
1984	1	Negl	1
1985	-	18	18
1986	22	-	22
1987	14	-	14
1988	123	14	137
1989	44	-	44
1990	76	-	76
1991	-	-	-
1992	8	-	8
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	38	-	38
1997	-	-	-
1998	-	-	-
1999	-*	-	-
2000	-*	-	-
200 1	-#	-#	-#

* Unconfirmed reports from the Netherlands Antilles as well as FDA detention reports (Caribbean Overview, appendix F2d2) and NMFS COE data (appendix F2a3) suggest that there were small fresh swordfish shipments to the United States in 1999 and 2000. It is unclear why these shipments were not reported in the U.S. import data.
# Through June
Source: U.S. Bureau of the Census

Appendix D2a2.--United States. Swordfish imports from the Netherlands Antilles, 1975-June, 2001

Year	Quantity			Total
	With Aruba	Without Aruba		
	Metric tons			
1975	-	-	-	-
1976	-	-	-	-
1977	-	-	-	-
1978	-	-	-	-
1979	-	-	-	-
1980	-	-	-	-
1981	16.1	-	-	16.1
1982	41.9	-	-	41.9
1983	-	-	-	-
1984	0.4	-	-	0.4
1985	8.1	-	-	8.1
1986	9.6	-	-	9.6
1987	5.8	-	-	5.8
1988	26.8	-	-	26.8
1989	-	6.6	-	6.6
1990	-	8.5	-	8.5
1991	-	-	-	-
1992	-	2.0	-	2.0
1993	-	-	-	-
1994	-	-	-	-
1995	-	-	-	-
1996	-	12.1	-	12.1
1997	-	-	-	-
1998	-	-	-	-
1999	-	-	-	-
2000	-	-	-	-
2001	-#	-#	-#	-#

Through June
Source: U.S. Bureau of the Census

Appendix D2a3.--United States. Swordfish Certificate of Eligibility (COE) data from the Netherlands Antilles, June 1999-May 2000

Month/ country	Year		Shipments
	1999#	2000#	
	Kilograms		
January			
February			
March			
April			
May			
June			
July			
August	574		3
September	160		1
October			
November			
December			
Total	734		4

Source: Susan Linn, National Seafood Inspection Laboratory, computer run, September 21, 2000

Appendix D2a4.--United States. Swordfish and tuna imports from Aruba, 1990-June, 2001

Year	Species	
	Swordfish	Tuna
	Metric tons	
1990	-	1.0
1991	-	-
1992	-	-
1993	-	-
1994	-	-
1995	-	-
1996	-	-
1997	-	-
1998	-	-
1999	-	-
2000	-	-
2001	-#	-

Through June
Source: U.S. Bureau of the Census

Appendix D2b1.--United States. Tuna imports* from the Netherlands Antilles, 1990-June 2001

Year	Value
	US$ Million
1975	5.0
1976	5.8
1977	4.3
1978	7.8
1979	10.1
1980	14.4
1981	4.6
1982	1.2
1983	0.1
1984	0.5
1985	6.4**
1986	6.3**
1987	0.5
1988	3.9
1989##	12.2**
1990	0.1
1991	0.2
1992	Negl
1993	-
1994	0.9
1995	5.7**
1996	14.1**
1997	18.8**
1998	18.3**
1999	14.8**
2000	15.8**
2001	0.4#

Note: Separate data for individual islands is not available.
* Given the dimensions of shipments, 90 percent or more in any given year is transhipped product.
** Mostly albacore
# Through June
Beginning in 1989, U.S. import data separates imports from Aruba from the Netherlands Antilles.
Source: U.S. Bureau of the Census

Appendix D2b2.--United States. Tuna imports* from Trinidad and the Netherlands Antilles, 1990-June, 2001

Year	Value		Total
	Trinidad	Neth Ant**	
	US$ Million		
1990	2.0	0.1	2.1
1991	1.6	0.2	1.8
1992	0.4	Negl	0.4
1993	0.9	-	0.9
1994	4.5	0.9	5.4
1995	10.7	5.7	16.4
1996	17.8	14.1	31.9
1997	21.2	18.8	40.0
1998	30.5	18.3	48.8
1999	37.0	14.8	51.8
2000	25.7	15.8	41.3
2001	9.5#	0.4#	9.9#

* Given the dimensions of shipments, 90 percent or more in any given year is transhipped product.
** Presumably this is mostly Taiwan-caught fish transshipped through St. Maartens.
# Through June
Source: U.S. Bureau of the Census

Appendix D2b3.--United States. Tuna imports* from the Netherlands Antilles, 1998-2000

Commodity/ Species	Value			
	1997	1998	1999	2000
	US$ Million			
Fresh	-	-	0.1	0.1
Frozen				
Albacore	18.7	18.3	14.6	15.6
Skipjack	Negl	Negl	Negl	Negl
Yellowfin	-	-	0.1**	Negl**
Other	-	-	-	Negl
Total	18.8	18.3	14.8	15.7

* Given the dimensions of shipments, 90 percent or more in any given year is transhipped product.
** Heads off eviscerated
Source: U.S. Bureau of the Census

Appendix D2c.--United States. Seafood detentions from the Netherlands Antilles, 2000

Company	Product	Date	Reason
Nichirei Carib	Frozen yellowfin	02/07/2000	Filthy
Nichirei Carib	Frozen bigeye	02/07/2000	Filthy

Source: FDA, OASIS detentions.

Appendix D3.--European Union. Swordfish imports from the Netherlands Antilles, 1991-99

Country	Commodity	Year								
		1991	1992	1993	1994	1995*	1996	1997	1998	1999P
		Metric tons								
Denmark	Frozen trunks	-	-	8	-	-	-	-	-	-
France	Frozen trunks	7	7	-	-	-	-	-	-	-
Germany	Frozen trunks	-	23	18	47	2	-	-	-	-
Spain	Frozen trunks	152	99	22	12	-	-	-	2P	-
Total		159	129	48	59	2	-	-	2P	-P

Note: Virtually all of this swordfish was Taiwan-caught fish transhipped through St. Maarten. The authors are unsure why shipments or reporting stopped in 1995. Technically this fish should have been reported as imports from Taiwan. This i how it is reported by Japan. U.S. data, however, also tends to report it as imports from the Netherlands Antilles.
P - Preliminary
* The available EU data suggests that imports from the Netherlands Antilles dropped sharply in 1995. This may well be the case. The sharp change in 1995 shipments, however, could also reflect EU statistical changes, such as the handling of transshipments. The authors note that one observer in 1999 reported continuing shipments to Germany. Gerard Van Buurt, Netherlands Antilles Fisheries Section, personal communications, April 9, 2001.
Source: EU. Eurostat data

Appendix D4.--Japan. Swordfish and marlin imports from the Netherlands Antilles, 1986-94

Year	Quantity	
	Billfish	Swordfish*
	Metric tons	
1986	352	117E
1987	65	22E
1988	6	2E
1989	10	3E
1990	7	2E
1991	-	-
1992	-	-
1993	-	-
1994	-	-
1995	-	-
1996	-	-
1997	-	-
1998	-	-
1999	-	-

E - Estimated swordfish proportion of billfish shipments.
Source: Japan Tariff Association, *Japan Exports & Imports*, various years.

Appendix E.--Netherlands Antilles. Seabird nesting, 1984

Area	Information	Species*	Known** threats	Importance***
Windward group				
St. Martin	Good	3, 5-6, 11-13?, 16, 18-19?, 20, 22	Ex, Ha, Pr?	Important
Saba	Good	3, 5-6, 10?, 13, 18, 22?	Ex, Ha?, Pr?	Relatively unimportant
St. Eustatius	Good	3, 5-6	Ex? Pr?	Relatively unimportant
Leeward group				
Bonaire	Good	3?, 7?, 12-13; 15-20	Ha, Po	Important
Curaçao	Good	12??, 17?, 20	Ha	Relatively unimportant
Aruba	Good	11, 12?, 15-20	Ex, Po, Ha	Very Important

* Species: 3 - Puffinus I. lherminieri; 5 - Phaethon aethereus; 6 - P. lepturus; 7 - Fregata magnificens; 10 - Sula leucogaster; 11 - Pelecanus occidentalis; 12 - Larus atricilla; 13 - Sterna maxima, 14 - S. sandvicensis acuflavida; 15 - S. (s.) eurygnatha; 16 - S. dougallii; 17 - S. hiundo; 18 -S. anaethetus; 19 - S. fuscata; 20 - S. (albifrons) antillarum; 22 - A. stolidus
** Threats: Ex - exploitation of eggs, young or adults; Pr - predators, generally introduced mammals; Ha - habitat destruction or disturbances; Po - pollution; Fi - fisheries
*** A rough subjective rating of relative importance of area for breeding seabirds.
Source: Ruud van Halewyn and Robert L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), "Status and conservation of the world's seabirds," *ICBP Technical Publication*, No. 2 (ICBP: Cambridge, 1984), pp. 175-176.

Appendix F.--Netherlands Antilles. Species glossary

English	Dutch/local*
Amberjack	Brazil/brazile
Barracuda	Piku
Bigeye scad	Marsbango/masbangu
Billfish	Balau
Marlin	
Blue	Blancu
White	Salmau/cora
Sailfish	Wairu/di bandera
Spearfish**	Blancu
Croaker	Colbino
Dorado***	Dradu
Drums	Colbino
Grouper	
Large	Goetoe/poeroenchi
Small	Jacupeper/janpauw/meru
Jack	Brazil/brazile
Kingfish****	Conoves
Oilfish	Kaka sin sinti
Pampano	Dradu
Rainbow runner	Grastelchi
Sardine	Sochi
Sea trout	Colbino
Shark	Tribon
Snapper	Pargo/pisca corra
Snook	Picu
Swordfish	Balau tonini
Tuna	Buni/tuna
Albacore	Habricos
Bigeye	Wowo di baca/fluitdo
Blackfin	Pretu/buní
Skipjack	Karet/porco/bonito
Yellowfin	Halfash
Wahoo	Mula

* The local name is not always the same Dutch word used in the Netherlands. Although the official language of the Netherlands Antilles is Dutch, in the Leeward Group (Aruba, Bonaire, and Curaçao) Papaimentu is commonly spoken and contains words derived from Dutch, English, Portuguese, and Spanish. In fact the varied linguistic make up of the Netherlands Antilles can be seen in the species names. Several species have names close to the Spanish name for the fish. In the Windward Group (Saba, St. Maarten, and St. Eustatius), English is the colloquial language.
** Longbill spearfish, *** Dolphinfish, **** King mackerel
Source: Various

18

PUERTO RICO

Puerto Rico has a small mostly artisanal fishing industry. The island's narrow shelf and relatively unproductive Caribbean waters limit the island's largely demersal fishery. Heavy fishing pressure on this limited resource has reduced yields in recent years. The overall fisheries catch is quite small and the domestic market is primarily supplied from the U.S. mainland and imports from foreign countries. Fishermen use small boats and largely traditional gear and methods. The Congreso de Pescadores is promoting more efficient methods and is acquiring a commercial boat for a test project. A new fisheries law which the officials hope will be approved is 2001 is designed to better manage the available resource.

While the Puerto Rican fishery is largely a demersal fishery, some fishermen also target pelagic species. The pelagic fisheries catch is quite small. Fishermen use small boats and handlines/trolls to catch tuna, dorado, wahoo, and other species. The annual tuna catch is less than 100 tons. More than 100 Puerto Rican fishermen have obtained general tuna permits allowing them to use handline and troll gear for tuna. There is only limited actual Puerto Rican pelagic longlining. A few small longliners have been briefly deployed in coastal waters, but none are actively conducting pelagic fisheries for tuna, swordfish, and related species. There appears to be little interest among Puerto Rican fishermen in initiating a commercial longline operation. A few fishermen have deployed small demersal longlines for shark and other species.

Mainland U.S. longline fishermen deploy commercial longliners for swordfish in the northwestern Caribbean and western Atlantic. The mainland longliners work out of San Juan on a seasonal basis. When the catches decline off the U.S. northeastern coast in November, as many as 70 mainland longliners have shifted their operations south to the Caribbean and adjacent areas. While mainland longliners were very active in the mid-1990s, these Caribbean area operations have declined and in 2001 only a few U.S. longliners have been working out of San Juan.

While swordfish catches by the Puerto Rican fishermen are minimal, the island's domestic and offshore mainland longline fishery is of some interest in any Caribbean assessment because it has been more thoroughly studied than most other Caribbean fisheries. While fisheries research on pelagic species has been limited, there is some interesting work underway at the University of Puerto Rico. A National Marine Fisheries Service observation program is in place for pelagic longliners which provides important information on wider-Caribbean operations. The observers report that while marine mammal and seabird interactions in the Caribbean do not occur, sea turtle interactions appear higher than in surrounding areas. NMFS hopes to implement a vessel monitoring (VMS) program for pelagic longliners.

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Figure 1.--Map of Puerto Rico and offshore islands (Mona, Culebra, and Vieques).

I. Overview

A. Background

1. History

The Arawark (Taino) Indians populated Puerto Rico, which they referred to as "Borinquen". The more war-like Carib Indians raided the Tainos and made a few settlements. Columbus discovered the island on his second voyage in 1493 and named it San Juan. The Spanish did not settle the island, however, until Juan Ponce de León was given a charter by the King of Spain to colonize the island in 1508. After San Juan was founded the island began to be referred to as Puerto Rico (Rich Port). The Indians were enslaved to work gold mines which were quickly depleted. The Indian population was devastated by the brutal conditions of slavery and European diseases to which they were exposed and had no immunity. The Spanish, unlike the English, did not generally bring their wives to the New World. Many thus took Indian wives and many Puerto Ricans today claim both Spanish and Indian ancestry. Much of the interior of the island was settled by such mixed couples which farmed small holdings. The cities of Ponce and Mayagüez were established in the late 1700's.

Many English, French, and Dutch military expeditions in the 16th and 17th century seized Caribbean islands. Some were unclaimed others were taken from the Spanish. The European naval powers, however, found it difficult with their relatively small military contingents to subjugate the larger Spanish islands (like Puerto Rico, Hispaniola, and Cuba) that had substantial Spanish populations. For this reason, the smaller Caribbean islands became English, French, and Dutch colonies while the larger islands remained Spanish. The Spanish built a series of massive fortifications to defend their Caribbean possessions. These included El Morro and San Cristobal, which still stand guard over the entrance to San Juan harbor--a reminder of the Spanish colonial past. The imposing fortifications played a key role in preventing the English and Dutch from seizing the island.

Puerto Rico for two centuries had mainly a small farm economy. Spain gave little attention to its colony. There were periods for over 10 years when no ships arrived from Spain. Puerto Rico was, however, like other Spanish colonies, prohibited from trading with other countries. Illegal trade with the English and Dutch developed. Ginger became a crop of considerable importance. In the early 19th century, the Spanish Crown granted a "Cédula de Gracia" to increase the European population of Puerto Rico. The Spanish Government awarded land grants to immigrants from South American colonies, Spain, and other European countries. Cities and towns began to grow during this period. Another consequence was that the agrarian economy began to change from small farms to large coffee and sugar plantations. As a result, African slaves were imported in large numbers for the first time. This relatively late appearance of plantation agriculture meant that slavery was never as important on Puerto Rico as it was on several other Caribbean islands. Slavery was not abolished, however, until 1873.

Puerto Ricans took arms against the Spanish, beginning with the "Grito de Lares" in 1868. The

Photo 1.--The massive Moro castle once protected San Juan from marauding English privateers. It still stands as a symbol of Puerto Rico's Spanish heritage. D. Weidner

Spanish were able to maintain control, but granted Puerto internal self government in 1897. The Spanish-American War which broke out in 1898 was largely fought in naval engagements off Santiago (Cuba) and Manila (the Philippines) and in land battles around Santiago. United States troops also landed on Puerto Rico at Guanica, July 25, 1898. The war ended before any heavy fighting began on the island. The local government in San Juan declared loyalty to Spain, but did not oppose the U.S. soldiers. The United States demanded Puerto Rico as "war payment" from Spain in the Treaty of Paris. Puerto Ricans were granted U.S. citizenship in 1917.

Photo 2.--The interior of Puerto Rico is quite hilly with only. Much of it is divided into small agriculture holdings with some preserved parks and forrest areas. D. Weidner

Economically Puerto Rico at first languished under American control. Little economic development took place and the island was further devastated by the Great Depression which began with the 1929 stock market crash. American corporations owned many plantations and sugar factories. They paid low wages and repatriated much of the profit. This began to change with New Deal programs. Puerto Rico was granted partial self government in 1947 and a new constitution establishing a Commonwealth was adopted. The new Commonwealth officials proceeded to initiate programs like "Operation Bootstrap" which stimulated growth and attracted investment, creating the largest most diverse economy of all the Caribbean islands.

2. Government

Puerto Rico's first elected governor was Muñoz Marin in 1948. Puerto Rico became a Commonwealth associated with the United States in 1952. The Commonwealth Government in many ways serves the function of a state government. Puerto Ricans are U.S. citizens, but island resident do not vote in the U.S. Presidential elections. They do send one non-voting representative to the U.S. Congress (House of Representatives). Puerto Ricans elect a Governor and a bicameral Legislature comprised of the Senado and Cámara de Representantes. Puerto Rican residents do not pay federal income tax. As U.S. citizens Puerto Ricans resident in the mainland United States do vote in presidential elections. Puerto Ricans do participate in Social Security and serve in the armed forces.

Puerto Ricans are divided as to the future of their island. Many Puerto Ricans believe that the island should become a U.S. state which would make it the first non-English speaking state. This is becoming an increasingly viable option as Spanish is becoming increasingly spoken in the mainland United States. Many other Puerto Ricans believe that the current Commonwealth status is the most beneficial status for the island and should be continued. A much smaller, but vocal number of Puerto Ricans believe that the island should pursue independence.

3. Economy

Puerto Rico has the most dynamic and diverse economy of all the Caribbean islands. Industry has surpassed agriculture as the main stay of the island's economy. Puerto Rico's economy is currently based on the many factories established since the 1950s through duty free access to the U.S. market and tax incentives. Many of the subsidies are now no longer in effect. Important industries include pharmaceuticals, electronics, petrochemicals, textiles, and processed foods. Sugar, once the most important crop, has declined in importance as dairy and livestock husbandry has grown. Although once a largely self-sufficient agricultural society, Puerto Rico now imports 90 percent of the food consumed on the island. Tourism is also important, but accounts for only 7 percent of the economy--a smaller proportion than many other Caribbean islands.

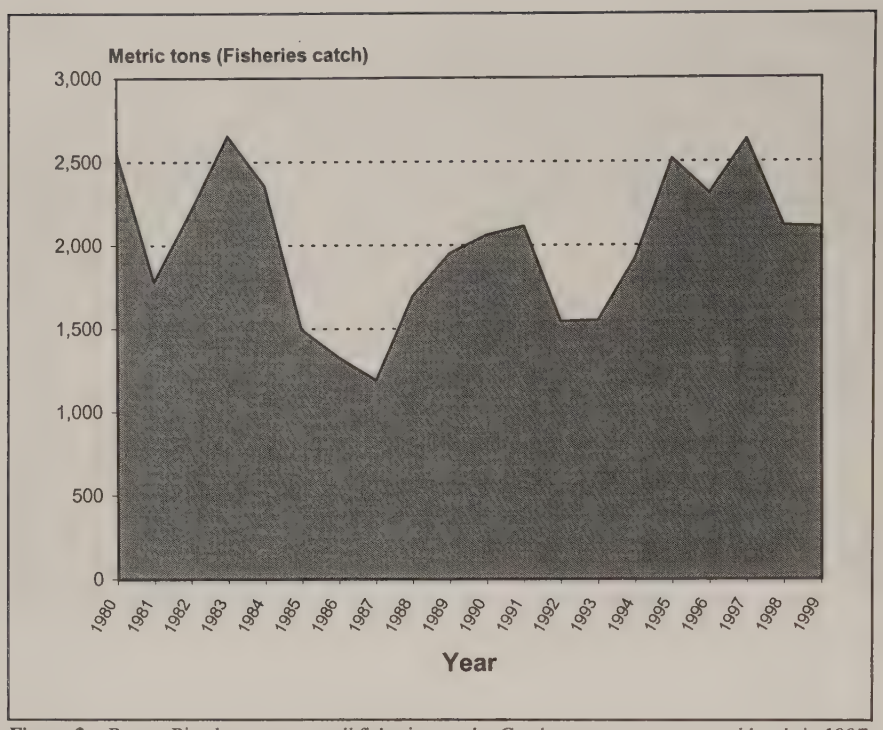

Figure 2.--Puerto Rico has a very small fisheries catch. Catches were at near record levels in 1997, but officials report yields are very low because of heavy fishing effort.

B. Fishing industry

Puerto Rico has a very small fishing industry which plays only a minor role in the economy. The value of the commercial catch (mostly artisanal) was less than $8 million in 1999.[1] Two primary factors limit the potential of the Commonwealth's fishing industry.

Narrow shelf: Puerto Rico has a very narrow shelf, in some areas, especially along the northern coast, only extending out from the shore a few kilometers (km). The resulting small area of shallow water grounds severely limit the stocks of demersal species. Substantial pressure on those limited stocks in recent years has further reduced populations and yields in the fishery.

Low productivity: Caribbean fisheries in general are notable for the low natural productivity of the water.[2] One Puerto Rican researcher has addressed the subject of productivity in the Caribbean, using remote sensing data.[3] There are local exceptions in the Caribbean where upwelling is prevalent and supports especially productive fisheries. Off Puerto Rico, for example, some moderate upwelling occurs in the southern Mona Channel during the summer.[4]

The Puerto Rican fishing industry is primarily an inshore fishery, focusing on the limited demersal reef resources. The fisheries pursued by the island's mostly small-scale artisanal fishermen are generally multiple-species fisheries. Almost all gear take a variety of species. The nature of the substrate limits the types of gear deployed by fishermen on their inshore grounds. The most commonly used fishing method and gear in Puerto Rico is currently hook and line ("cordel y anzuelo").[5] Various types of lines account for about 40 percent of the catch. Traps account for about 25 percent of the catch. Net fisheries (beach seines, gillnets, and trammel nets) are also of some importance.[6] Some limited longlining is also conducted (appendix C1). The use of traps has

Photo 3.--Puerto Rican fishermen deploy large numbers of traps, but yields are very low. In 2001 there were no limits on the numbers of traps fishermen could deploy. Julio Serano

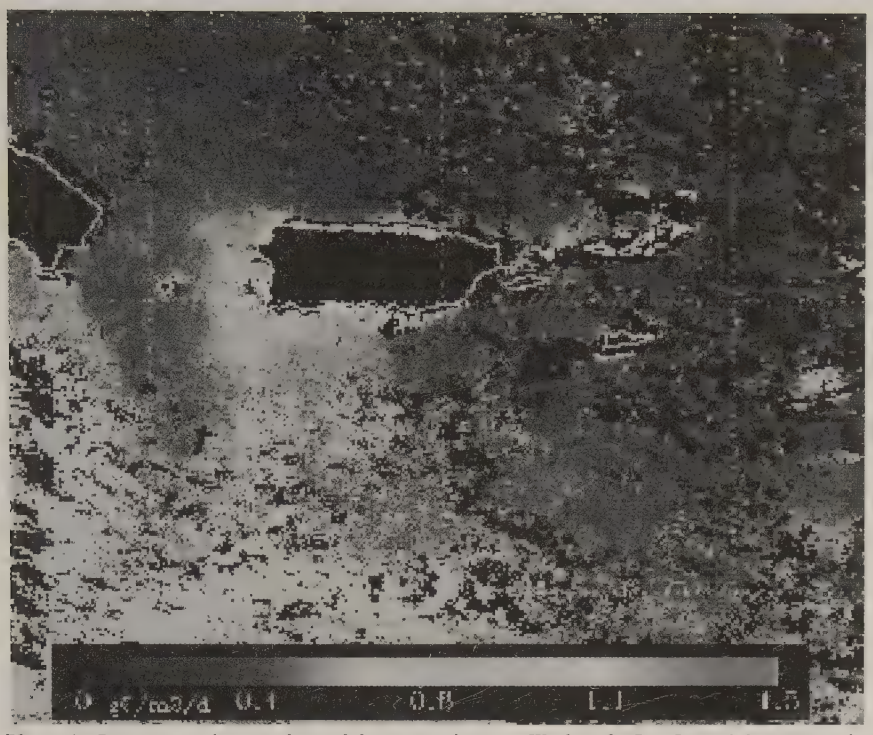

Photo 4.--Primary productivity limits fisheries production. Work at the Bio-Optical Oceanographic Laboratory is assessing primary productivity and upwelling. University of Puerto Rico--Mayagüez

increased.[8] The use of gillnets has increased in substantially.[9] Some local observers are especially concerned with this increasing use of monofilament gillnets.[10] Fishermen report their largest catches along the island's western coast.

The Puerto Rican fisheries catch in 1998 totaled over 2,100 metric tons (t), about average for the 1990s (appendix D1a). The catch during the 1990s ranged from a low of 1,500 t in 1992 and 2,600 t in 1997. Officials are concerned about the heavy fishing effort on many inshore demersal stocks, especially reef fish, queen conch, and lobster. Puerto Rican officials believe that the intensive effort on these species has resulted in serious overfishing.[11] These fisheries exhibit many of the classic signs of over fishing, declining landings of several species, falling CPUEs, harvesting of smaller fish, and failing recruitment.[12] Officials report that in many cases large fish have become very rare on Puerto Rican reefs.[13] Fishermen report better catch rates at greater distances from the coast, probably reflecting the heavy effort on the inshore grounds which the small boat fishermen target.[14] Other factors may be involved. One report suggests that long term oceanographic processes may possibly be a factor in stock declines by affecting recruitment.[15] As a result of the heavy pressure on demersal stocks, officials are encouraging the fishermen to diversify by targeting less heavily fished pelagic species. (See "XIII. Government Policy.")

declined during the 1980s (appendices C3b-c), but continues to be important in the local fishery. The fishermen in 1998 set about 10,000 traps for finfish and 4,000 pots for lobster.[7] Some trap fishermen have apparently shifted to line fishing which in the late 1980s accounted for as much as 35 percent of the island's catch (appendix C3c). The use of nets has also

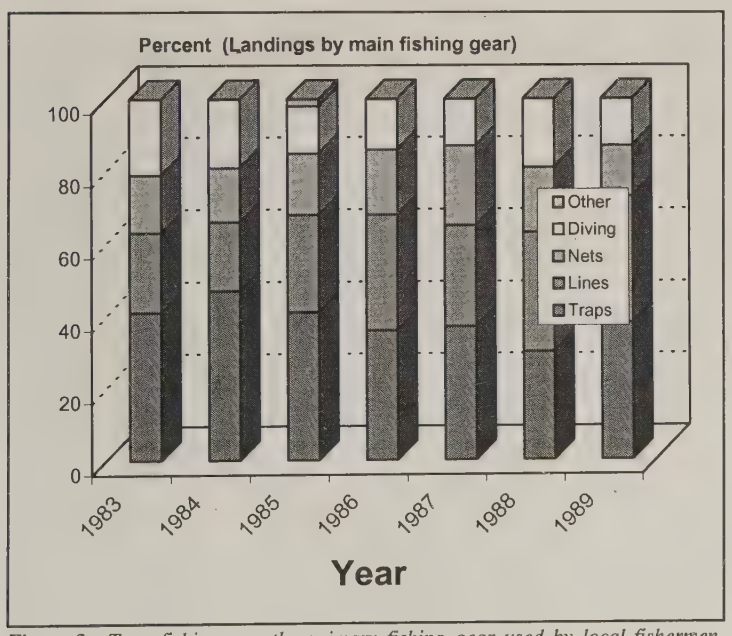

Figure 3.--Trap fishing was the primary fishing gear used by local fishermen. Traps are still widely used and many believe they contribute to the low yields reported by artisanal fishermen.

The overall catch trend since 1980 is highly varied. The authors can discern no clear overall trends. Catches have ranged from 1,200 t (1987) to 2,700 t (1983). The 1992 catch was near the low of the range, 1,500 tons. The 1997 catch was near the high end (appendix D1a). The wide fluctuations in the Puerto Rican catches are difficult to assess because available published sources such as FAO group catches in large basket categories such as demersal and pelagic "perciformes". The FAO data suggests that the difference during the 1990s is largely in demersal

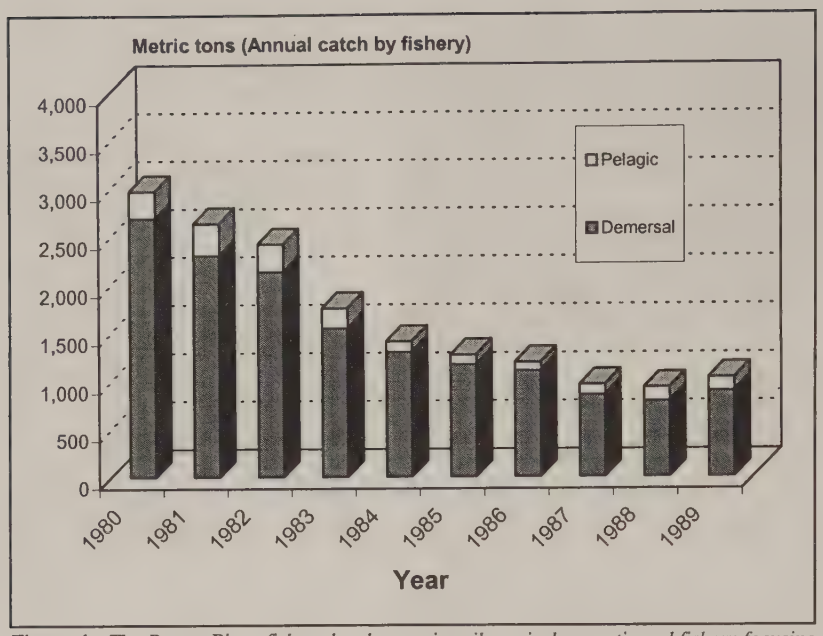

Figure 4.--The Puerto Rican fishery has been primarily an inshore artisanal fishery focusing largely demersal species.

species.[16] NMFS reports fluctuations during the 1990s in demersal species (especially snappers), but also fluctuations in pelagic species (mackerel, tuna, and dorado) and even larger fluctuations in shellfish (conch and lobster).[17] Curiously, both FAO and NMFS reply primarily on data reported by Puerto Rican authorities.

Like most Caribbean fisheries, the species taken by Puerto Rican fishermen are quite diverse. Reef species like snappers and groupers have been a favored species. Heavy fishing pressure, however, appears to be altering the species composition. The principal species now taken in the important demersal fishery include snappers, groupers, grunts, parrotfish, triggerfishes, and goatfishes.[18] Some of these species like parrotfish and tangs (surgeonfish) are species that the fishermen once discarded as undesirable. This is one of several indicators of heavy fishing pressure on the available resource.[19]

Fishery resources in the northeastern Caribbean from Puerto Rico to Antigua appear relatively limited.[20] Puerto Rican fishery officials have been concerned for some time that the fishery resources, especially demersal resources, on the Virgin Islands-Puerto Rican shelf are overexploited.[21] While not exhausted, officials report that stocks of many important species, especially prized demersal stocks, are declining and smaller fish are being harvested.[22] Officials in recent years have been encouraging fishermen to more heavily target less intensively exploited pelagic resources.

Puerto Rico like several other Caribbean islands is affected by ciguatera. Ciguatera has been reported off the southern coast of Puerto Rico and the Dominican Republic. The problem is also reported in several islands of the Lesser Antilles. One 1988 study found barracuda taken off the southwestern coast to be heavily affected, although levels varied seasonally.[23] Other species which can be affected include shallow-water snappers, cero mackerel, barracuda, some jacks, and it is occasionally reported on a variety of other species. Demersal species are generally affected more than pelagic species which are not normally affected, but occasional incidents are also noted involving several pelagics.[24]

***Photo 5.**--Puerto Rican artisanal fishermen operate small boats from isolated locations all along the coast. Their catch does not begin to satisfy the strong demand for seafood on the island. Julio Serano*

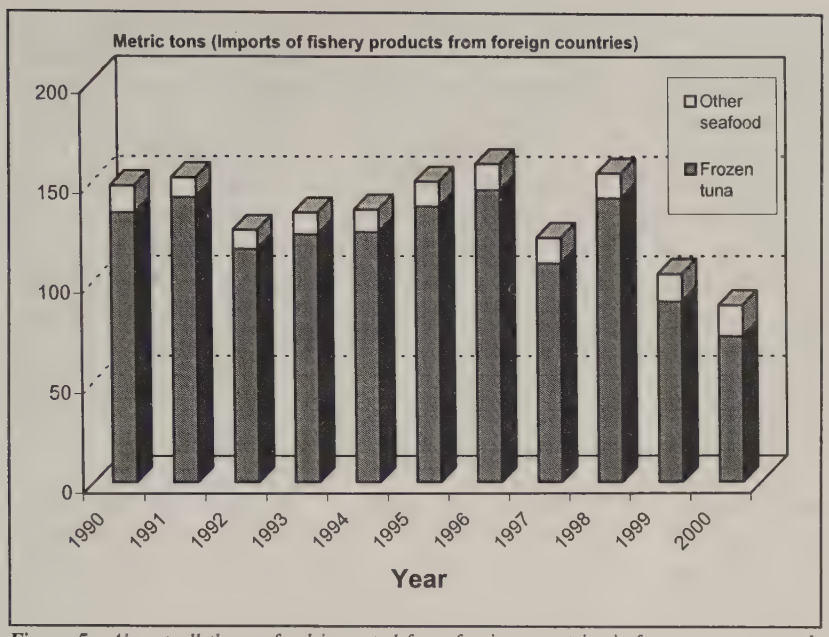

Figure 5.--Almost all the seafood imported from foreign countries is frozen tuna to supply canneries. Imports have dropped sharply in recent years as canneries have closed.

The small domestic catch only satisfies a minor part of the Puerto Rican demand for fishery products. Seafood has to be purchased from the mainland United States as well as imported from other countries, mostly Latin American countries. Much of the fish sold in supermarkets comes from the mainland United States or is imported from foreign countries.[25] Estimating these shipments is difficult because of Puerto Rico's Commonwealth status. FAO does attempt to estimate Puerto Rican fisheries trade.[26] One Puerto Rican source estimates that the domestic catch supplies less than 10 percent of the island seafood market (appendix E1). U.S. data can be used to estimate the trade in fishery products with foreign countries. This does not, however, include fishery products imported from the mainland United States, but detailed data on trade between Puerto Rico and the mainland United States is available from the U.S. Census Bureau.[27] Direct fishery imports into the Puerto Rican Customs district (San Juan) have fluctuated from $190 million (1991) to over $300 million (1996) (appendix F1b). Most of the imports, however, are frozen tuna which is not consumed on the island. The authors believe that a more accurate view can be obtained by excluding the very substantial frozen tuna imports, most of which are destined for canning and then shipped off the island--largely to mainland U.S. markets (appendix F3b). Actual imports consumed on the island have increased $30 million in 1990 to nearly $50 million in 2000 (appendix F1b). This is, however, almost certainly well below actual purchases as it does not include seafood obtained in the mainland United States.

Most of Puerto Rico's fishery resources, as is the case throughout the Caribbean, are shared resources. This is obvious for pelagic species, especially oceanic pelagics like swordfish, tuna, and billfish. Even demersal resources which in their adult life stage are relatively sedentary on individual island shelves, were generally pelagic in juvenile life stages. The migration and dispersal of these species highlights the need for cooperation among fishery managers on the various Caribbean islands. The recruitment of marine animals from one island shelf to the other, however, is no fully understood. Another author stresses that the commonly held view of

Photo 6.--Taiwan is the main foreign supplier of albacore tuna to local canneries. Some albacore is transhipped through St. Maarten, but only small amounts from the Trinidad operations shown here. D. Weidner

a smooth westerly flow following the Antillian and Caribbean Currents is a great oversimplification. One author stresses that the current pattern and movement of marine organisms is greatly complicated by gyres, back flows and eddies.[28]

An important part of the U.S. tuna canning industry is located in Puerto Rico. The major companies involved in the U.S. tuna canning industry (such as Bumble Bee, Star-Kist, and Van Camp) were attracted by tax concessions covering operations and in some cases vessel construction as well as low labor costs. The mainland corporations built canneries at Mayagüez in northwestern Puerto Rico and Ponce along the southern coast.[29] At the time some U.S. seiners were operating in the Atlantic and Puerto Rico was closer to the operations off West Africa than the mainland United States. Eventually, however, Pacific-caught fish became more important. Foreign transshipments were available from nearby St. Maarten, especially albacore needed for white meat packs.[30] The tuna canned was mostly seiner-caught yellowfin and skipjack, but the transshipments from St. Maarten were largely longline-caught albacore. Canning in Puerto Rico, rather than a foreign country, allowed for duty free entry to the United States. There are excellent and frequent sea transport services to the United States, unlike many other Caribbean locations. Some Puerto Rican canneries have continued to operate even after the decline of the San Diego, California canneries where the U.S. industry was founded. The Puerto Rican canneries have, however, also been affected. Serious problems were reported as early as 1981.[31] Some of the canneries were closed in 1990 when the dolphin protection efforts added another problem to an already difficult competitive situation. Canneries in America Samoa and Asia proved to be formidable competitors. American companies closed or sold canneries.[32] Japanese companies like Mitsui bought some of the canneries. Other Puerto Rican canneries have been affected, such as the Carine cannery in Ponce which closed in 1995.[33] Hemispheric trade agreements like the Caribbean Basin Initiative, North American Free Trade Agreement and other planned hemispheric agreements, may impact the future of the tuna canning industry on Puerto Rico.[34]

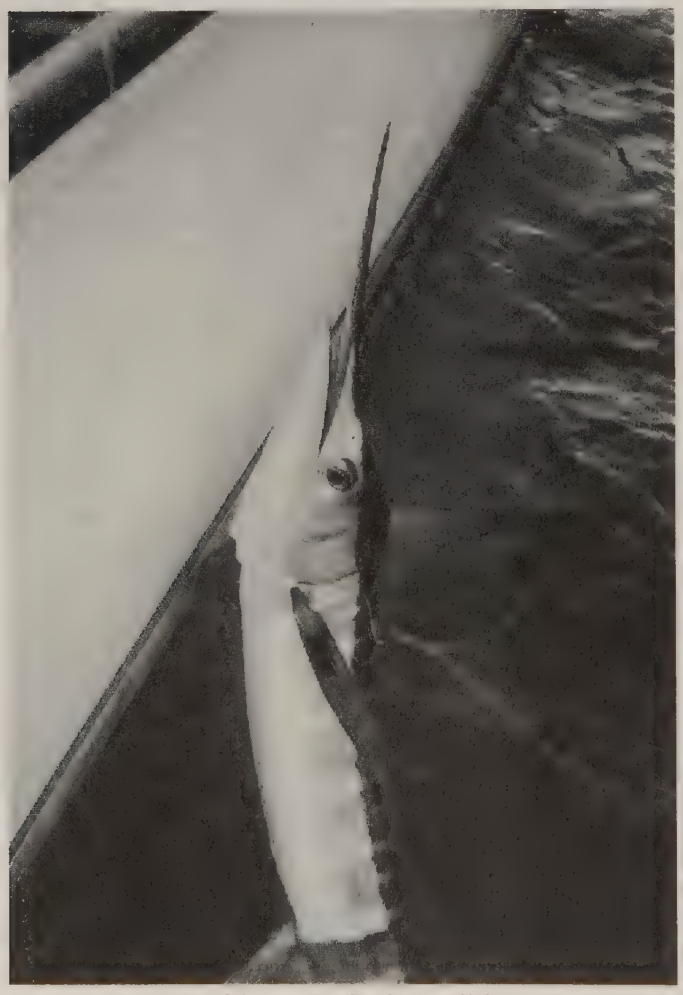

Photo 7.--Puerto Rican fishermen rarely take swordfish. Artisanal fishermen have take marlins, but they are now reserved for sports fishermen

Puerto Rican domestic fishermen report small tuna catches, but only minor billfish catches. The most important billfish is blue marlin. Swordfish catches are minimal. The few swordfish taken is largely the incidental catch of the small artisanal shark fishery. An important swordfish resource does occur off Puerto Rico and the island has played a major role in the fishery conducted by the U.S. mainland commercial longliners. The U.S. mainland fishermen operate primarily in the Atlantic east of Puerto Rico and the Virgin Islands. Operations are also conducted south of Puerto Rico, but to a much more limited extent. The fishermen use San Juan on Puerto Rico as their primary landing point. The excellent flight connections provide easy access to the U.S. market which is essential for the marketing of high-quality fresh swordfish and tuna. Landings in Puerto Rico by the commercial longliners vary significantly from year to year, but totaled less than 440 t of swordfish (live weight) in 1998 and only about 245 t in 1999 (appendix D3a), down substantially from 1995 levels. Preliminary indications suggest even further reductions in 2000 and 2001.

II. Species

The authors know of no Puerto Rican studies specifically describing swordfish behavior. Some scattered anecdotal reports are available from the U.S. fishermen operating longliners out of Puerto Rico. These fishermen report that fish taken during the spawning periods (December through March) often have dark or even brown bloodlines. This is especially true of large, sexually mature fish (over 45 kg, dressed weight).[35]

Researchers have done some work describing the behavior of oceanic pelagic species off Puerto Rico, but such research has been very limited. One now dated paper provided insights on spawning patterns off Puerto Rico. While it primarily addressed demersal reef fish and freshwater species, it also included some information on oceanic pelagics--including tunas, blue marlin, sharks, and dorado (dolphin fish).[36] The authors know of only a few other Puerto Rican studies dealing with oceanic pelagics.[37] One species that has been assessed by Puerto Rican researchers is dorado or dolphinfish (*Coryphaena hippurus*).[38]

A. Spawning

Researchers have found the reproductive capacity of swordfish to be phenomenal. Swordfish are batch spawners, the females release their eggs in successive batches during a protracted spawning season. Batch fecundity ranges from 1-9 million eggs, depending upon the size of the female. Spawning frequency is on average once every three days during the peak spawning season.[39]

The spawning grounds for swordfish are primarily deduced by the location and abundance of swordfish larvae. Several studies have assessed the presence of swordfish larvae in the western Caribbean, including the wider-Caribbean. These studies have provided some indication of spawning activity, but limitations on collecting larvae over a wide area have resulted in only a rough view of spawning activity in the wider Caribbean. One 1983 study reported that there is relatively little spawning within the Caribbean itself, although some limited spawning does take place south of Cuba. Considerable spawning activity is reported off western Cuba, both in the Yucatan and Florida straights (Cuba, figure 4). There appears to be no larvae concentrations in the Mona Channel between the Dominican Republic and Puerto Rico. There is, however, some spawning around the Lesser Antilles, primarily from north of Anguilla to St. Lucia. The larvae found in the Lesser Antilles are both small and large sized. The lesser numbers of small larvae suggest that spawning is less intense than in the western Caribbean off Cuba. The numbers of large larvae suggest that spawned are retained there or recruited from adjacent regions.[40] A 1998 analysis shows a similar pattern of larval concentrations in the Gulf of Mexico and U.S. southeastern coast, but some more limited concentrations off the northern islands in the Lesser Antilles (Venezuela, figure 10).[41]

NMFS initiated a reproductive study of western Atlantic swordfish in 1990. NMFS' Southeast

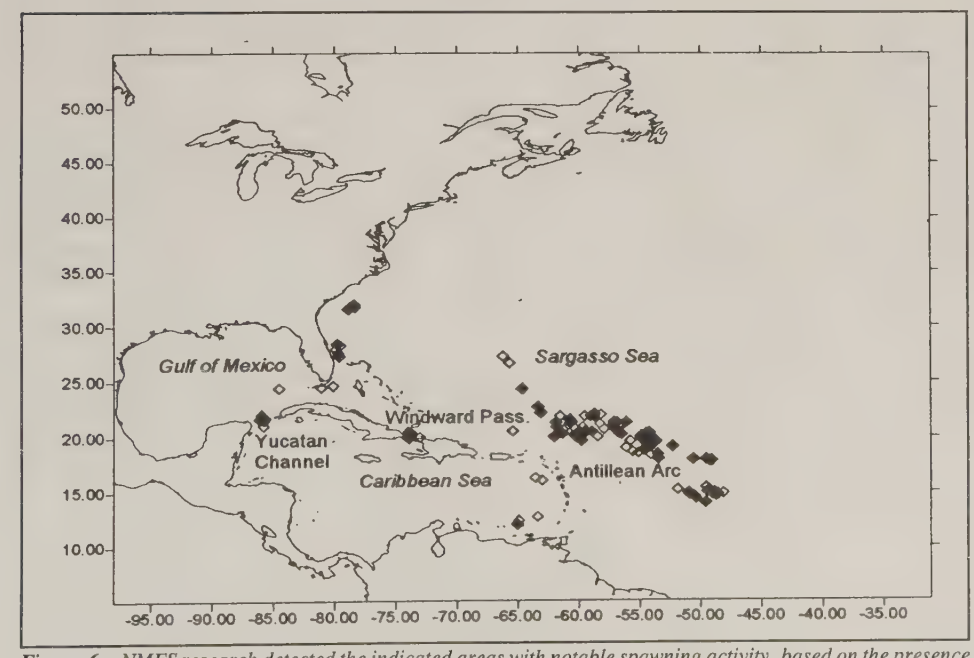

Figure 6.--NMFS research detected the indicated areas with notable spawning activity, based on the presence of females with hydrated oocytes. Cramer

Fisheries Science Center collected data on nearly 15,000 swordfish taken by commercial longline fishermen in the northwestern Atlantic. The results suggest that much of the spawning activity for swordfish in the north Atlantic takes place in the wider-Caribbean, but outside the Caribbean Arc east of Puerto Rico. Some of the major findings included:

Size: The minimum length at maturity was 150 cm LJFL for females and 105 cm LJFL for males. The proportion of mature females increased markedly for females 179 cm long and all females were mature by 195 centimeters.

Area: The major spawning observed in the NMFS study appeared to be south of the Sargasso Sea, east of Puerto Rico beyond the Antillian Arc (figure 6). Other spawning areas appeared to be the Windward Passage and Yucatan Channel as well the southeastern United States. Spawning was not noted in the Mona Passage between Puerto Rico and the Dominican Republic. Although numerous samples were taken in the eastern Caribbean north of Venezuela, very limited spawning activity was noted there.[42]

Season: The main spawning season is from December through June, based on the occurrence of females with hydrated oocytes (egg type in the final stage prior to ovulation and spawning) in their ovaries. The spawning activity varies within the season with the peak months of January, February, and May. Note that this corresponds to the peak fishing season out of San Juan (figure 9).

B. Migration

There is still only limited information available on swordfish migratory behavior. This is especially true for migratory patterns in the Caribbean. The best evidence on swordfish movements comes from tagging. Tagging swordfish, however, has proved to be a difficult proposition. One of the biggest problems is the small number of fish taken by the catch and release recreational fishery. The problem is especially compounded within the Caribbean basin as there is relatively limited fishing even by commercial fishermen.

There have been some limited tag returns in the Caribbean. Most of these have been reported east and southeast of Puerto Rico within the Caribbean basin or well east of the island in the Atlantic. Many of the these tag returns have been reported by the U.S. longline fleet operating from Puerto Rico (San Juan) and the U.S. Virgin Islands. Several factors explain the concentration of tag returns from these areas.

United States: U.S. fishermen usually focus on swordfish and are thus more likely to take it than many

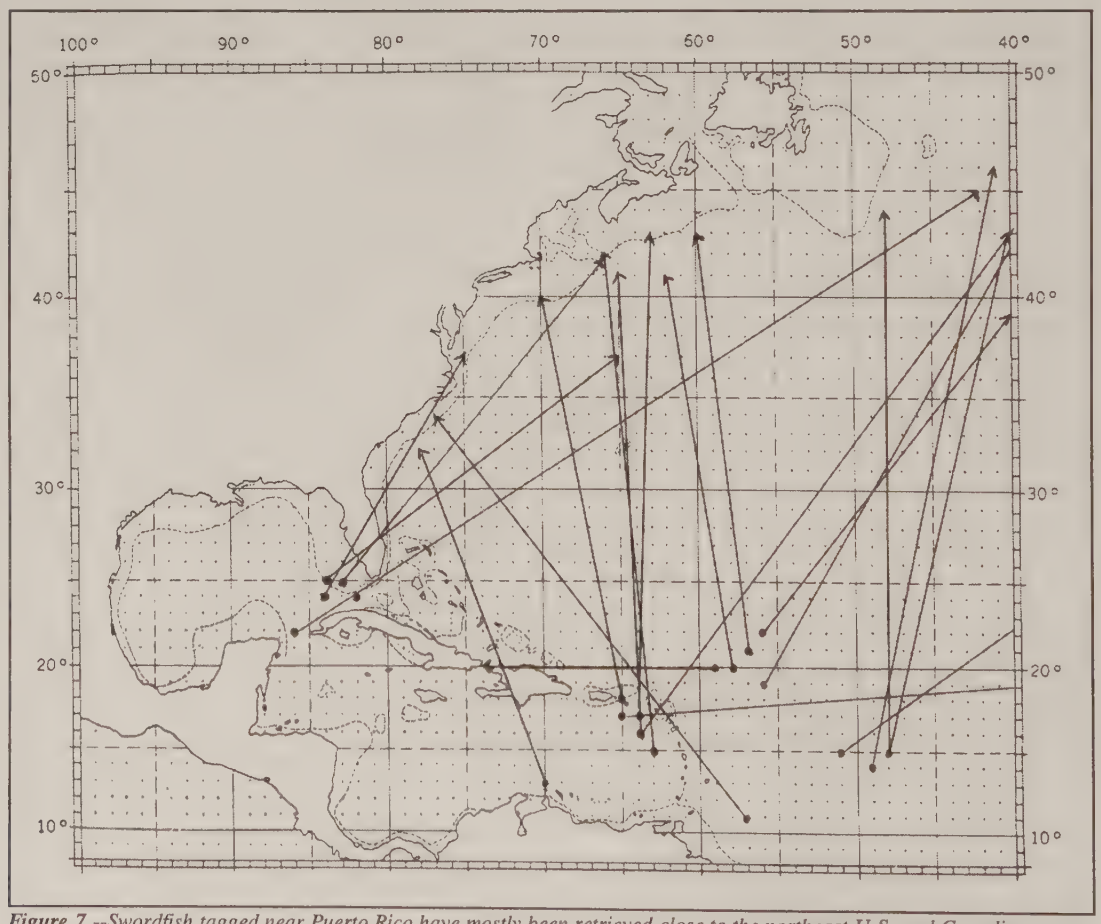

Figure 7.--Swordfish tagged near Puerto Rico have mostly been retrieved close to the northeast U.S. and Canadian coasts. Some fish tagged further out in the Atlantic have been retrieved further east.

other longline fishermen. U.S. fishermen are also likely to release juveniles which can then be tagged. The concentration of U.S. fishing east and southeast of Puerto Rico also reflects the fishing practices and patterns of the U.S. fleet (figure 15). This is, in part, a reflection of abundance. Other factors, however, such as enforcement of 200-mile EEZs also reflect fishing patterns. The U.S. commercial fishermen are also more likely to participate in tagging fish and returning tags.

Eastern Caribbean: As described in the individual island reports, several islands have developed longline fisheries. These fisheries, however, do not generally target swordfish and their total take is relatively small. None are known to participate in tagging programs.

Venezuela: Venezuelan fishermen are through the efforts of the Universidad de Oriente tagging fish and participating in tagging programs. Relatively few Venezuelan tags have, however, been retrieved.

Cuba: Cuba reports only minor longline effort for swordfish within the Caribbean Basin. The Cuban costal fishery for swordfish has primarily been conducted off the island's northwest coast.[43]

Japan: Japanese longliners work out of Colombian ports. The vessels do not seem to be involved in any tagging program.

Taiwan: Taiwan longliners work out of St. Maarten (Netherlands Antilles, appendix A3) southeast of Puerto Rico. These vessels make occasional sets in the Caribbean, but report much greater effort to the north (Turks and Caicos and Bermuda) as well as in the tropical Atlantic. Even larger numbers of Taiwan longliners work out of Trinidad (Trinidad, appendices A4-5). The vessels involved are almost all different than those working out of St. Maarten (Trinidad, appendix 6). The vessels do not appear to be involved in any tagging program.

Available tag returns, while limited, do provide some insights into possible swordfish migratory behavior around Puerto Rico. The available tag evidence appears to confirm the widely held belief that swordfish after spawning migrate from sub-tropical wider-Caribbean waters to rich feeding grounds at temperate latitudes and then return south to the Caribbean in the fall and winter. A growing number of tag returns exists for fish tagged around Puerto Rico and fish tagged elsewhere and then moved toward the Caribbean and recovered around Puerto Rico.

Northward movement: Swordfish have been tagged both within and beyond the Caribbean basin.

Within the Caribbean Basin: Tag reports exist for five swordfish tagged southeast of Puerto Rico within the Caribbean Basin , just west of the northern Lesser Antilles. Four of these fish have moved north to latitudes of 40° or more within a relatively narrow range of the U.S. and Canadian coast from 63-70°W (Caribbean Overview, appendix C3). This shows movement to northern feeding grounds, probably by following the Antillian or Caribbean Currents east an then the Gulf Stream north. One fish (HM01776) shows an extensive eastward migration to an area west of Cape Verde. This fish may have been involved in a lengthy migration following the North Atlantic Gyre back to the Caribbean, but this is only conjecture at this time.

Beyond the Caribbean Sill: Two clusters of tagged swordfish have been reported east of Puerto Rico and the northeastern Caribbean. Most of the fish have been retrieved on northeastern feeding grounds off the coast of the United States and Canada and on the Grand Banks. Interestingly, the fished tagged west of 57°W tend to be retrieved west of that point and the fish tagged east of 57°W tend to be retrieved east of that point. The authors are unsure why that may be, but it could just be a statistical anomaly due to the small number of tag returns.

Southward movement: Several fish tagged in the north Atlantic have been retrieved east of Puerto Rico, both within and outside of the Caribbean Basin. Presumably these fish were migrating back to the Caribbean after feeding on rich northern grounds.

Within the Caribbean Basin: Two swordfish tagged at different locations along the U.S. coast were retrieved southeast of Puerto Rico.

Beyond the Caribbean Sill: Several fish tagged around the Grand Banks were retrieved northeast of Puerto Rico in the Atlantic. Interestingly, all of these fish were tagged east of 50°W, most on or near the Grand Banks. One fish was tagged in the central Atlantic.

While the limited number of tag returns preclude any definitive assessment, they do suggest an annual movement northward following the Gulf Stream and then a return to Caribbean feeding grounds in the winter months.[44] The use of archival tagging combined with an assessment of the increasingly available genetic work should provide a much clearer picture in the future of swordfish migration patterns and behavior.[45]

C. Sizes

The Southeast Fisheries Science Center in Miami maintains detailed data on the sizes of the swordfish landed by U.S. fishermen. This extensive data base provides information on variations in the number of fish being landed in the different size categories. The data can not be readily used to assess swordfish populations, however, as management restrictions require that small fish be discarded and the data is only maintained for the fish landed. Other regulations have

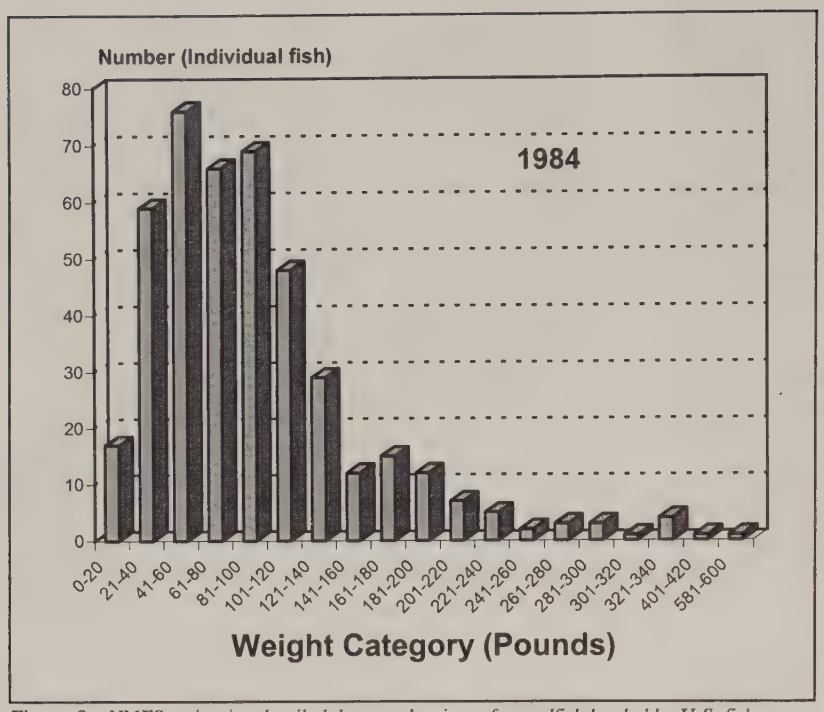

Figure 8.--NMFS maintains detailed data on the sizes of swordfish landed by U.S. fishermen, including where it was caught and landed.

varied over time which complicate the interpretation of this data. The data is used as part of NMFS's annual resource evaluation which is submitted to ICCAT and is used in combination with data from other countries to assess swordfish populations.

One notable observation is that the U.S. mainland longline fishermen report that some of the largest swordfish are taken in the Caribbean. Caribbean fish in 1998-99 were 38.1-39.6 kg (dressed weight. The average swordfish U.S. longliners landed in the north Atlantic were 34-34.9 kg (Caribbean Overview, G1c12).

D. Seasonality

Swordfish landings reports from U.S. fishermen show variations from year to year. The general seasonal pattern, however, is quite similar. Detailed information on landings trends is available from the U.S. fleet since 1984. The data since 1985 provides a good view of seasonal catch trends. The best landings are usually from December or January to April or May. Landings begin to decline in April and continue at low levels from June through November. The lowest catches are generally in August and September. A sharp increase usually begins in December (appendix B3).

Caution needs to be exercised in assessing the U.S. landings data (appendix B3). Some of the factors which should be considered are:

Effort: Effort was not constant. Most of the fishermen cease operating out of San Juan during the warm summer months to fish in the more productive grounds off New England. As a result, the landings data may exaggerate actual abundance trends. Some swordfish are present year round. The months for which no swordfish landings are reported for the most part mean that there was no fishing, not that fishermen did not find any swordfish.

Trip length: The fishermen normally make about 15 day trips. Thus there is a slight difference between when the fish was actually caught and when it was landed.

Data validity: U.S. longlining landings in San Juan have dropped to very low levels. The data beginning in 1998 is thus less useful than earlier years when fishing was more intense.

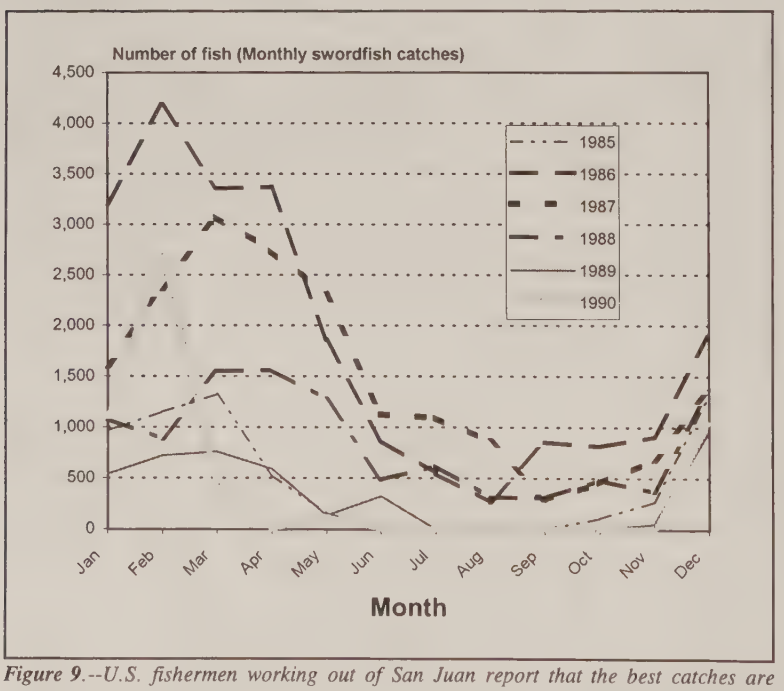

Figure 9.--U.S. fishermen working out of San Juan report that the best catches are usually taken from December or January through April. Catches then begin to decline in May.

III. Grounds

Puerto Rico is the smallest and eastern-most island of the Greater Antilles. It is located about 1,550 kilometers (km) southeast of Miami and located between the Dominican Republic to the west and the British Virgin Islands to the east.

The oceanography and topography of the western Atlantic is of considerable importance in assessing swordfish. The fish are know to be associated with the continental slope and Gulf Stream. There are probably also important relationships with other currents and topographical features, although they are at this time less well established.

A. Oceanography

1. Currents

The current flow around Puerto Rico is complex. It is dominated by two westerly flowing currents. The Antillian or North Equatorial Current flows along the northern coast. The Caribbean Current flows along the southern coast. While these two principal currents flow westerly there are many inshore eddies and backflows which complicate the general pattern, especially along the southern coast. Like many Caribbean islands, Puerto Rico is on a shallow sill between the Caribbean basins and the North American Basin of the north Atlantic Ocean. The deepest water in the U.S. EEZ is found in the Puerto Rico Trench at the southern boundary of the North Atlantic Basin.

a. Caribbean

The Venezuelan Basin along the southern coast of Puerto Rico is one of a succession of five basins (figure 10), separated by sills of 700-1,200 m which comprise the Caribbean. Combined with the Gulf of Mexico, the Caribbean is referred to in one study as the American Mediterranean Sea.[46] Other authors refer to the Intra-Americas Sea.[47] The basins are surrounded by an island-studded sill and the South, Central, and North American land masses. The Venezuelan Basin is bordered on the north by the Dominican Republic, Puerto Rico, and the Virgin Islands; on the east by the Aves Ridge; the south by Venezuela and the Venezuelan and Dutch Archipelagoes; and partially in the west by the Beata Ridge. The Caribbean is a Mediterranean sea similar to the Australian Mediterranean Sea--a dilution basin in the tropics. The Caribbean has, however, a significant evaporation loss and except for the Mississippi in the Gulf of Mexico, no major freshwater gain. Evaporation exceeds precipitation by over 1 m annually. Thus the Caribbean would appear to be more of a concentration basin. Salinities are, however, quite low by north Atlantic standards and, as a result, there is little deepwater convection and renewal of deepwater as commonly associated with concentration basins. The low salinities are primarily because of the massive, but seasonal flow of fresh water from the Amazon and, to a lesser extent, Orinoco outflows carried into the Caribbean by the Guianas and Caribbean currents. This massive advection enters the Venezuelan Basin primarily through the Eastern passages to the south of Puerto Rico in the Lesser Antilles. Water from the Amazon and Orinoco Rivers comprises about

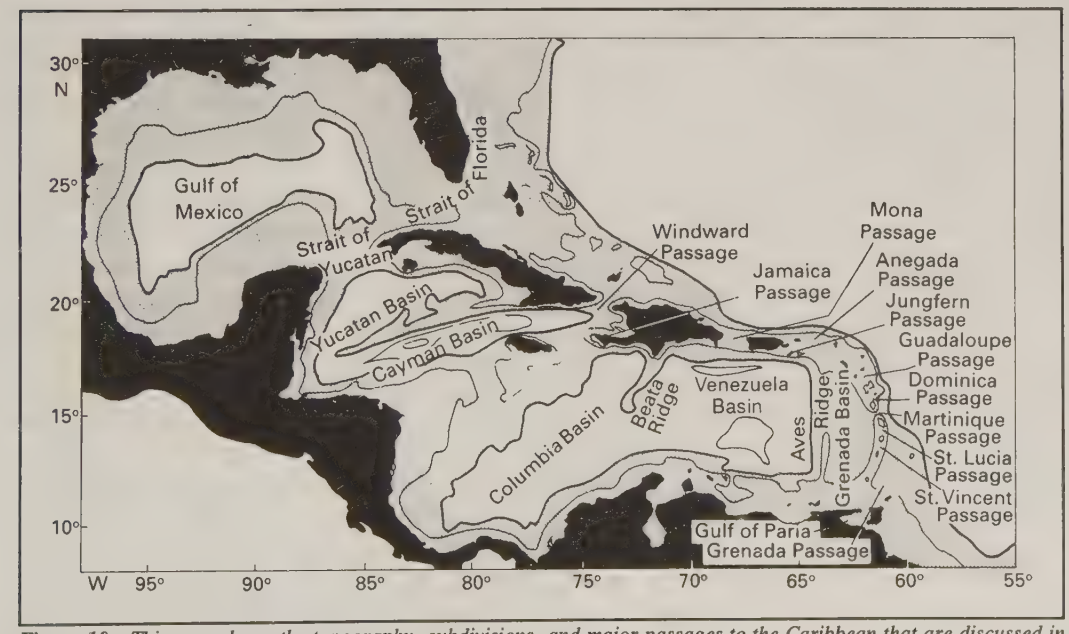

Figure 10.--This map shows the topography, subdivisions, and major passages to the Caribbean that are discussed in this section. Tomczak and Godfrey

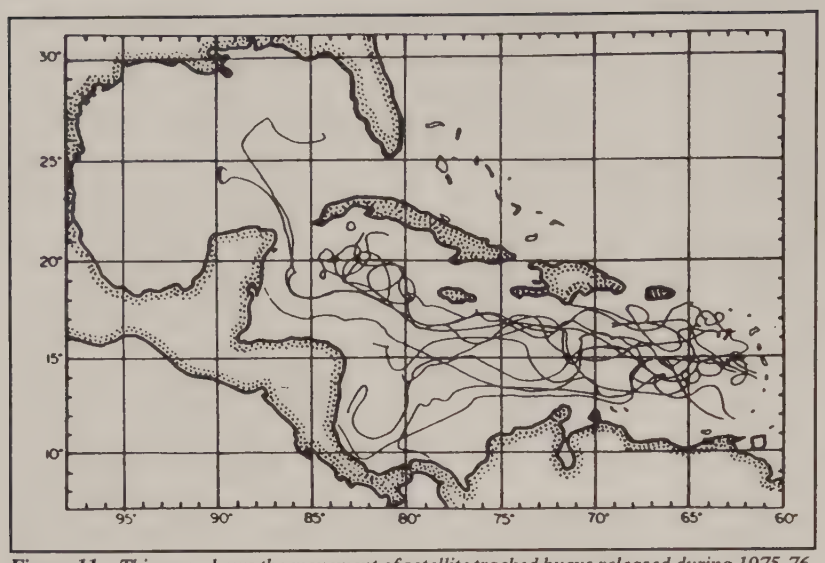

Figure 11.--This map shows the movement of satellite tracked buoys released during 1975-76. Kinder

15-20 percent of the surface water which enters the Caribbean.[48] Most of the Orinoco water enters the Grenada Basin, first through passages in the southerly Leeward passages of the Lesser Antilles--especially around Trinidad. The Orinoco water then flows through to the Venezuelan Basin and then to the other Caribbean basins. The Amazon outflow is more complicated. The Amazon plume goes father out into the Atlantic and gets drawn into currents which take some of it further north. Thus some Amazon water reaches Puerto Rico and flows into the Caribbean through northeast passages like the Anegada Passage.[49]

Current flow in the Caribbean is not nearly as pronounced as the Gulf stream familiar to most Americans. The surface current flow through the Caribbean Sea has been well documented by drifting buoys which are tracked by satellites (figure 11). The tracks show relatively slow current speeds in the easterly Grenada Basin and moderate, relatively stable speeds in the central basins, including the Venezuela Basin to the south of Puerto Rico. The Caribbean Current demonstrates speeds of only 0.2m s^{-1} in the Grenada Basin and 0.5m s^{-1} in the Venezuela, Colombia, and Cayman Basins. In contrast, speeds of 0.8m s^{-1} are reported in the Yucatan Strait between Mexico and Cuba. Such speeds are lower than in other western boundary currents. Current speeds can be lower than in the associated eddies, making the Caribbean Current highly variable. A systematic easterly flow embedded in the usual overall westerly flow is notable in the Grenada and possibly Venezuela Basin. Observations on the Aves Ridge show a banded easterly flow of varying strength near 13°N, southeast of Puerto Rico and St. Croix (U.S. Virgin Islands). This easterly flow eventually exits the Caribbean, entering the Atlantic as the Caribbean Counter Current (CCC) (figure 12).[50]

Figure 12.--Some of the major currents affecting the Caribbean, including the North Atlantic Subtropical Gyre, Caribbean Current, Caribbean Counter Current (CCC), and Antillean Current (AC). Tomczak and Godfrey

The current flow immediately around Puerto Rico, like any island, can be very complex. One author studied wind-driven pressure and current flow around Puerto Rico.[51] The northern branch of the Caribbean Current lies about 100 km south of the island, but varies seasonally (figure 13). The

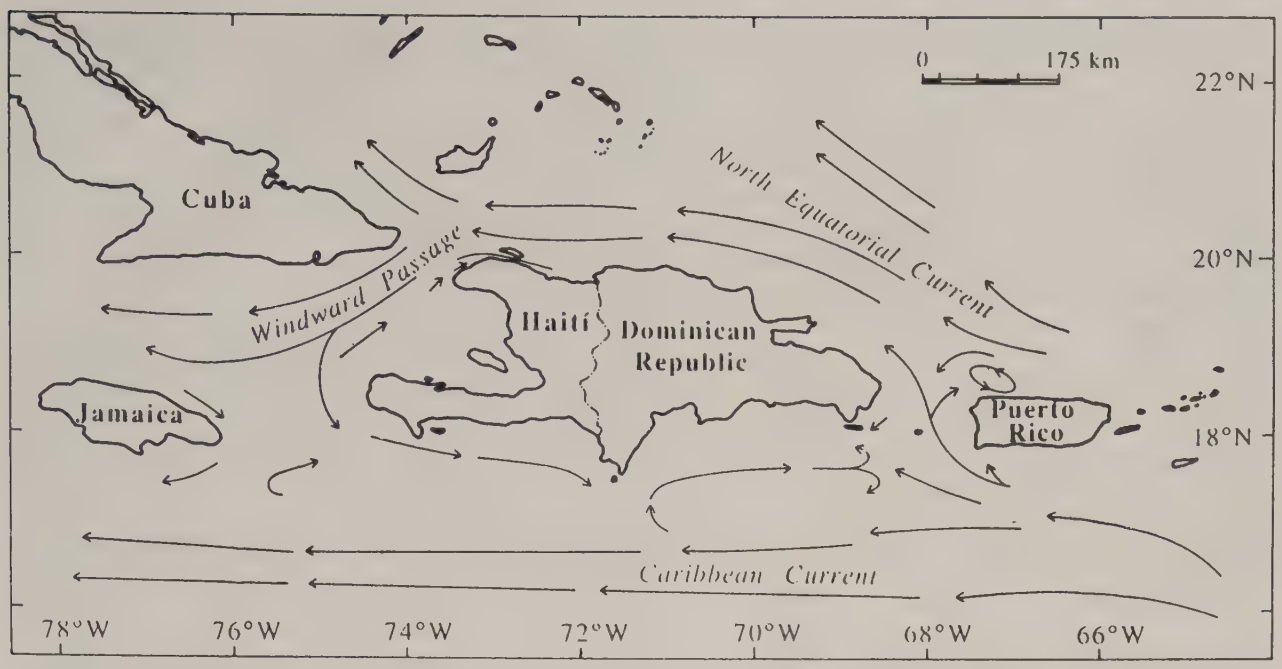

Figure 13.--This map shows the major current flow around the Greater Antilles. There are seasonal fluctuations and this map is more representative of the winter pattern. Appeldoorn and Meyers

current pattern between the southern coast and Caribbean Current can be quite varied. The current flow along the southern coast is generally westerly, although this changes as the current moves west to Hispaniola.[52]

b. Atlantic

The current structure in the Atlantic to the north and northeast of Puerto Rico is associated with the Subtropical Gyre and the North Equatorial Current.

Subtropical Gyre: A feature of each ocean basin are gyres, which are circulations bounded by contours of zero stream function value. The north Atlantic Subtropical Gyre is a loop current originating in the Gulf Stream (figure 12). Water from this northern hemisphere Gyre circulates clockwise, moving westerly off Puerto Rico's northern coast. The Azorian Current is part of the Subtropical Gyre and feeds the Canary Current.[53] Water flow breaks off from the Gyre, which eventually rejoins the Gulf Stream, north and northeast of Puerto Rico. This flow enters the Caribbean through the Mona Passage east of Puerto Rico as well as passages further east such as the Anegada and Jungfern passages. The Mona Passage is a particularly shallow passage. The Anegada and Jungfern passages east of Puerto Rico are much deeper with a far greater transport of water (Caribbean Overview, appendix B1). These passages, especially the Anegada Passage have been the subject of considerable investigation.[54] The Caribbean Current is in effect the most southerly component of the north Atlantic Subtropical Gyre.

North Equatorial Current: The North Equatorial Current is essentially the most easterly circulation of the north Atlantic Subtropical Gyre. The North Equatorial Current forms by breaking off from the Canary Current in the Eastern Atlantic (figure 12). It flows westerly combining with the Subtropical Gyre and is then sometimes referred to as the Antillean Current. It enters the Caribbean through passages in the northerly Leeward Islands of the Lesser Antilles, especially the Anegada and Jungfern passages. The Current then combines with the westerly moving Caribbean Current. Currents off the northwestern coast of Puerto Rico in the Mona Channel are particularly complex. There is both flow into and out of the Caribbean through the Mona Channel. There is a persisting loop current of varying intensity off the northwestern coast of Puerto Rico. Further off shore the North Equatorial Current splits (figure 13). The northern branch flows north of Silver and Navidad Banks to form the Bahamas Current. The southern branch moves along the northern coast of Hispaniola. A small persisting gyre of varying intensity is reported off Puerto Rico's northwestern coast. Flows through the Mona Channel are quite varied and strongly influenced by local tidal flows.[55]

2. Wind regime

The predominant winds in Puerto Rico come from the northeast, but are influenced by land and sea breezes. Thus along the southern coast the wind is generally from the southwest. The wind is strongest during the spring and summer and weakest during the fall and winter. Even so, the fall hurricane season can brings storms of enormous strength and last several days.[56] Ocean conditions usually reflect the wind patterns:

North: Waves are highest along the northern coast where sea breezes reinforce the northeast Trades. The north coast also faces the open Atlantic and thus is unprotected from waves generated in the north Atlantic.

South: The southern coast faces the more tranquil Caribbean and thus sea conditions are usually more calm than along the northern coast.

Puerto Rico is located in the Atlantic hurricane belt. The island has been devastated by periodic large storms. The land and human impacts of these storms are the most obvious results of these storms. There are also impacts in the marine environment which scientists are just beginning to study. Some assessment exist on shoreline and inshore waters, especially coral reefs. Hurricane David struck Puerto Rico in August 1979. Researchers have assessed the impact on reefs located along the southwestern coast.[57] One of the most serious hurricanes to strike Puerto Rico was Hugo in September 1989.[58] Another major storm was Hurricane Marilyn in 1995 which devastated the U.S. Virgin Islands, bringing an end to the swordfish longline operations that had developed there.[59]

3. Temperatures

Sea surface temperatures in the Caribbean, except for the Gulf of Mexico, never fall below 25°C. Temperatures commonly vary seasonally from 25-26°C during the winter to 28-29° during the summer. Temperatures off southern Puerto Rico during much of the year are similar to surrounding areas in the Venezuelan Basin, although the water to the north and east beyond the Antillean arc in the Atlantic are slightly cooler (Venezuela, figures 16-20). Temperatures off Puerto Rico during the first half of the year exhibit pronounced temperature shifts moving north from the island. Water as cold as 25°C can be found very close to the island, only about 100 km to the north during this time. During the second half of the year (often July through December), temperatures are similar to surrounding areas in the Western Atlantic. Water of 25° C at this time can be over 1,000 km or more to the north of the island.

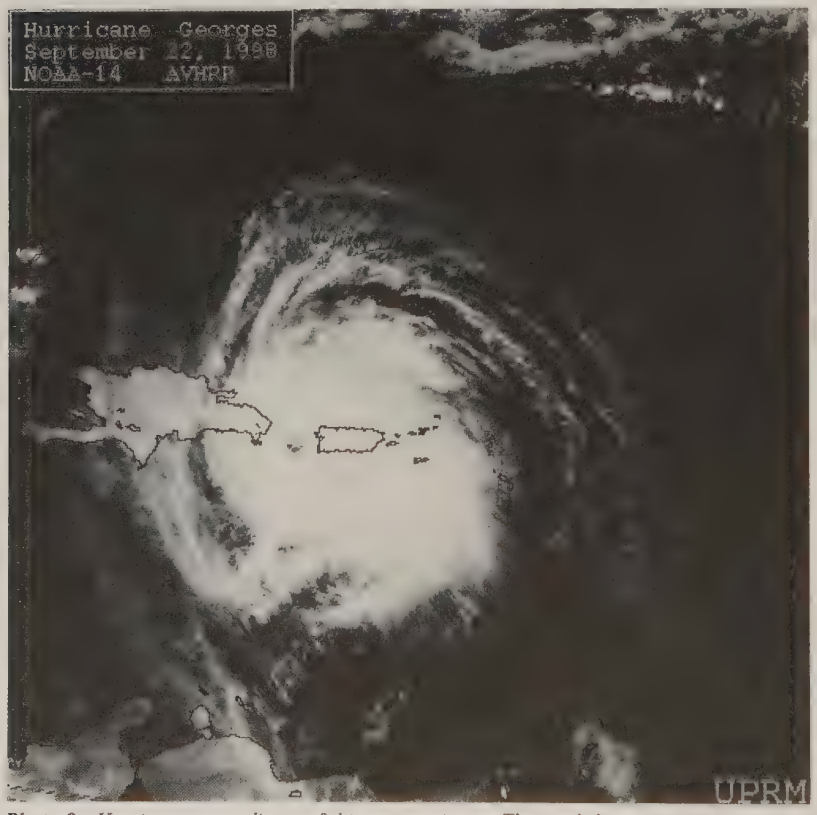

Photo 8.--Hurricanes can disrupt fishing operations. The peak hurricane season occurs during the fall--often before U.S. longliners begin to fish out of San Juan. University of Puerto Rico-Mayagüez

4. Freshwater inputs

Precipitation levels vary widely at different locations on Puerto Rico. There are areas of tropical rain forest along the northern coast while some southern areas, such as the area around Ponce, have much less rainfall. Precipitation ranges from more than 500 cm annually in the eastern mountains to less than 12 cm in the southwest.[60] There are no large rivers, but several fast flowing small rivers or streams exist, some of which feed into brackish coastal lagoons. The salinity of the oceanic water around Puerto is primarily influenced by the Amazon and Orinoco outflows. A Venezuelan report suggests that one of the major influences of salinity levels is the freshwater plume from the Orinoco River.[61] A Puerto Rican researcher reports that the influence of the Orinoco is primary felt in the southeastern Caribbean, especially around Trinidad.[62]

Photo 9.--Fishermen operate small boats from numerous small landing sites all along the coast. Conditions vary widely. William Folsom

B. Topography

Puerto Rico shares an insular shelf with the U.S. Virgin Islands (except St. Croix) and the British Virgin Islands. It is separated from the Hispaniola shelf to the west by the Mona Channel and the Anguilla Bank to the east by the Anegada Passage. Puerto Rico is a very mountainous island with steep insular slopes. As a result, except for the eastern coast there is a very narrow shelf.

Puerto Rican fishermen face a highly diverse oceanic topography and marine environment, depending on which part of the island they are based. There are coral and rock reefs, seagrass beds, mangrove estuaries, sand and algal plains, soft bottoms as well as sandy beaches. The bulk of the U.S. Caribbean EEZ lies to the north and south of Puerto Rico.

West: The EEZ is restricted to the west by the neighboring Dominican Republic. Small Mona Island is part of Puerto Rico. The Mona Passage connecting the Caribbean and Atlantic is targeted by longline fishermen, but less intensely than the Windward Passage. Swordfish and tuna are reported in these passages.

East: Puerto Rico's two largest off-shore islands (Cúlebra and Vieques) are located off the eastern coast. The U.S. Virgin Islands is also located to the east of Puerto Rico. The eastern coast has the islands largest shelf area. Nearly 45 percent of Puerto Rico's total shelf area occurs off the eastern coast. The bottom is mostly sandy with algal and sponge communities. Depths on the shelf vary from about 18-30 meters.[63] Along the southeast coast south of Vieques Island, the water gets deeper. The shelf is only about 8 km wide along the southeast coast. Grappler Bank, a small seamount, is located about 25 km southeast of the island and the top is about 70-m deep. The U.S. EEZ to the east is limited by the zones around the British Virgin Islands, Saba (Dutch) and St. Martins (Dutch and French).

North: The U.S. EEZ projects fully 200-miles north into the Atlantic. The waters to the north, however, are dominated by the Puerto Rico Trench which begins off the eastern tip of the Dominican Republic (about 61°W) and runs east all along the coast of Puerto Rico the U.S and British Virgin Islands, Anguilla, Antigua, and continuing further east into the Atlantic. The Trench off Puerto Rico begins about 50 km offshore. The shelf along the Puerto Rico's northern coast is very narrow, in places only 2-3 km wide. The water is often quite rough making fishing operations from small boats difficult.[64] There are few good harbors except San Juan in the east. The coast is a mixture of rocky and coral reefs and sandy beaches. Spectacularly deep water in the Trench, which can exceed 8,600 m occurs about 150 km north of Puerto Rico. Fauna in the deepwater of the Trench itself are very sparse.[65] The lack of fishing opportunities in the Trench off Puerto Rico is in sharp contrast to the Dominican Republic where fishermen along the northern coast can target demersal stocks on nearby shallow water banks.[66]

South: There is a substantial projection of the U.S. EEZ to the south of Puerto Rico, although marine boundary agreements have had to be negotiated with several other countries, the most important being Venezuela (figure 35). The Venezuelan EEZ projection around Aves Island in particular limits the U.S. EEZ. The shelf is about 10-20 km wide, narrow but broader than along the northern coast. Along the central coast an extensive area of sea grass extends out to Caja de Muertos Island.[67] The shelf than falls off into the Venezuelan Basin, one of five Caribbean basins separated by sills of 740-2,200 meters. The Venezuelan Basin is only about 50 km offshore. The

water there is deep, usually around 4,500-5,100 m, but not nearly as deep as found in the Puerto Rico Trench to the north. Along the southeastern corner of the island, the shelf widens to 25 kilometers.

Puerto Rico is densely populated. The population totals 3.8 million people or more than a thousand per square mile. As a result, the conflict between preserving the native forests and coastal habitat and the construction of needed housing and economic development is proving a great challenge. About a third of the island is forested and more than 80 percent of those forests are in private hands. Puerto Rico has a terrific potential as an eco-tourist destination, but it remains to be seen if this valuable resource will be recognized in time to protect it. About three-quarters of the coastal mangroves have already been destroyed, substantially reducing the area of critical wetland habitat. Some local environmentalists believe that the Commonwealth legislature does not fully recognize the need for forest, including mangrove, protection. Only 6 percent of the island is presently protected forest. As elsewhere in the United States, issues involving restrictions on the use of private property can be very controversial.

C. Fishing Grounds

1. Domestic fishermen

a. Artisanal

Puerto Rican has only a small artisanal fishing industry. The fishery is limited by the narrow shelf along much of the coast and the generally low productivity of tropical waters.[68] The fishermen face strikingly diverse conditions in coastal waters.

Northern coast: Fishing conditions are least favorable along the northern coast where there is little protection from the rough seas and northeasterly trade winds that prevail from November to March. The strong surges during this 5-6 month period make it difficult to operate in small boats, although some fishing is conducted from the shore. The shelf falls off precipitously into the deep waters of the Puerto Rico Trench, providing only a narrow shelf area and few coral reefs. Very little of the island's overall fisheries catch is taken off the northern coast (appendix C2a-d). The deeper water, however, off the northwestern coast, is where most of the artisanal fishery for oceanic pelagics is conducted. The artisanal fishermen take bonito, tunas, and occasionally a billfish--although swordfish catches are rare.[69]

Western coast: Conditions along the northwestern coast are similar to the northern coast, but in the southwest facing the Mona Passage there is a more ample shelf extending up to 27 km from the coast. The fishing area is restricted by the Dominican Republic Exclusive Economic Zone (EEZ). There are also highly productive reefs and several sheltered bays. Mangrove areas provide important nursery sites. As a result, fishing vessel deployment and catches are most intensive along the western coast (appendices A1 and C2a-d). Much of the pelagic catch is landed at villages along the western coast, especially the northwestern coast.[70]

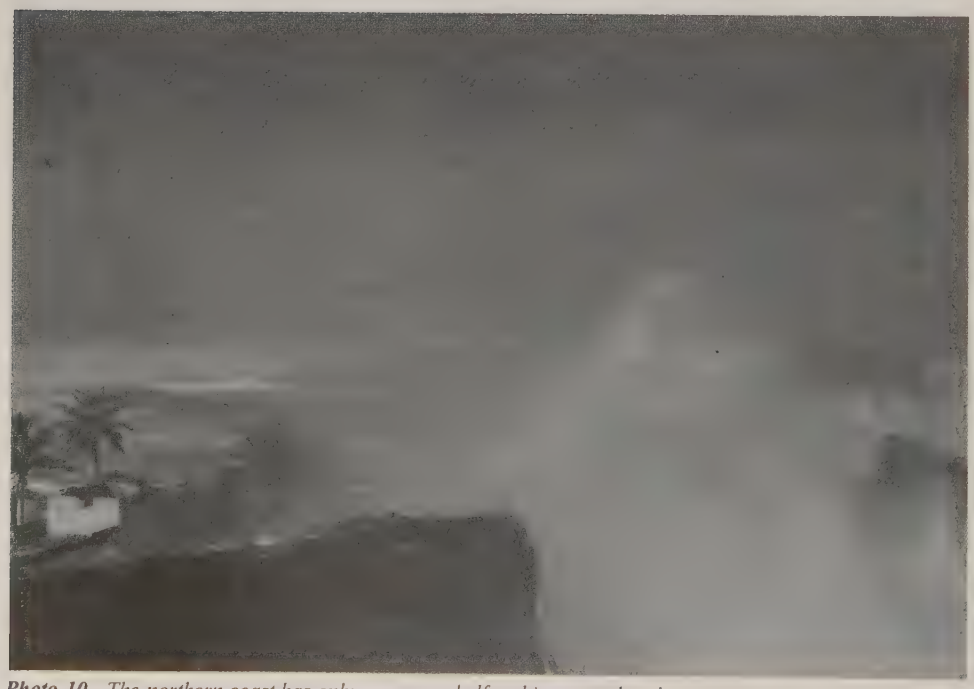

Photo 10.--The northern coast has only a narrow shelf and is exposed to the open ocean. Surf conditions can be very rough, especially during a storm. Grady Tuell

Photo 11.--The small boats operated by most Puerto Rican fishermen limit them to inshore operations. Julio Serano

Southern coast: The southern coast has an extensive shelf with sandy bottom, important coral reefs, extensive mangrove estuaries, and sheltered bays. Fishermen along the southern coast enjoy much calmer waters than faced along the northern coast. One of the most important fishing areas is along the southwestern corner of the island, because of the relatively broad shelf, calm sea conditions, and availability of good harbors.[71]

Eastern coast: Reefs, bays, and mangroves are also found along the eastern coast, although the northeastern coast is also exposed to rough sea conditions. Shelf area along the eastern coast is particularly extensive, comprising about half of Puerto Rico's total shelf area (100 fathom isobar).[72] Despite this large shelf area, the catch along the eastern coast is limited (appendix C2a-d).

Most of the Puerto Rican catch has traditionally been taken in coastal waters. This continues to be the case, but offshore activity has increased. One 1998 report suggested that from 1988-96, offshore activity increased nearly 50 percent.[73] This heavy pressure in part explains the declining yields from inshore operations. Increasing prices for fish may be another factor.

Puerto Rican domestic fishermen report small catches of several oceanic pelagics, mostly off the northern coast--despite the fact that only a small part of the Puerto Rican catch is taken along that coast. Virtually all of the small number of swordfish caught by domestic fishermen off Puerto Rico are reported along the northern coast.[74] The most important billfish species taken off Puerto Rico is marlin which is also mostly taken along the northern coast (appendix D1b). Some tuna is taken off the northern coast, but over half of the tuna catch is reported off the western coast (appendix D1b).[75]

The Puerto Rican fishery for oceanic pelagics is primarily centered along the northwestern coast. This is readily apparent in that nearly all of the NMFS permits issued for tuna are for fishermen based in northwestern ports, especially Aguada, Aguadilla, and Rincón (appendix A5). There are several reasons that the grounds targeted lay off the northwestern coast:

Topography: The northern coast has a very narrow shelf, thus fishermen in small boats can reach the deeper water where pelagics are found without going very far off the coast.

Migrations: The migratory pattern for tunas and several other pelagics bring them close to the coast where they are accessible to small boat fishermen.

Economic factors: Limited job prospects in northwestern Puerto Rico have created more interest in fisheries than elsewhere along the northern coast. Northwestern ports like Aguadilla are located at some distance from San Juan. Thus the men in these small ports do not have access to jobs in the city. Individuals in coastal villages further east can commute to San Juan.

Wave action: The wave action along the northwestern coast is more moderate than further east along the northern coast, making it easier to launch small boats.[76]

Puerto Rican artisanal fishermen operating on grounds off the northwestern coast do not conduct longline operations. The pelagic fishery is conducted with hand/troll lines.[77] Commonwealth regulations prohibit longlines over 8 km long in the Commonwealth's 9-mile waters. Even if permitted, few of the fishermen have longline experience. In addition, they do not have vessels large enough to conduct modern longline operations.[78]

b. Commercial

Puerto Rican artisanal fishermen primarily operate along the coast. A few larger, commercial fishermen, however, deploy multi-purpose vessels in international waters and foreign EEZs. These vessels have been deployed off the Bahamas, Dominican Republic, various islands in the Lesser Antilles, Colombia, Venezuela, Brazil, and other countries. One Puerto Rican official believes these vessels are especially active off the western coast and probably in neighboring Dominican waters.[79] The fishermen target a variety of species with different gear, but part of their activity includes longlining--primarily for tunas.[80] Puerto Rican authorities know virtually nothing about these operations. The fishermen are not required to report their catch outside the Commonwealth 9-mile limit to Commonwealth officials.[81]

2. Mainland U.S. fishermen

The U.S. mainland longliners fish extensively for swordfish in the western central Atlantic. In recent years most of the swordfish landed in Puerto Rico is taken in the Atlantic north and east of the island. Some fishing occurs in the Caribbean, but in recent years it has been generally limited. The most heavily fished area has been the Windward Passage between Cuba and the Dominican Republic (figure 10). Accounts vary somewhat as to the grounds most heavily targeted. One local observer reports that the U.S. longliners based in San Juan have generally concentrated their fishing activities 300-1,500 km east and southeast of Puerto Rico. Productive fishing grounds have been reported on the Mid-Atlantic Ridge, located approximately 960 km east of Puerto Rico.[82] One local official reports there is also some good fishing off the northern coast of Puerto Rico.[83] The log book data of U.S. longline fishermen compiled by NMFS reveal substantial annual variations. In recent years there has been relatively limited fishing within the Caribbean Basin, but considerable effort north and northeast of Puerto Rico. U.S. fishing appears to take place in a wide band extending southwest from the U.S. mainland coast (South and North Carolina) (figure 15). Even so the effort reported out of Puerto Rico is only a fraction of that reported along the U.S. mainland coast.[84] The captain of a group of U.S. mainland longliners reported that during the Caribbean offseason (May-October) the vessels are transferred to the Northeast Atlantic's Grand Banks, where swordfish catches are high.[85] Often the entire mainland fleets moves and in some months there are no longline landings at all reported in San Juan (appendix B3). Fishing effort has varied substantially from year to year, but operations were reduced in 1997 and sharply curtailed in 1998-99.

Reported activity of the U.S. mainland fleet in the wider-Caribbean during recent years is as follows: **1991**: After declining from peak 1986-87 levels, mainland longline activity leveled off in 1989 and continued little changed through 1993. The fishermen reported intensive fishing effort in the Atlantic northeast of Puerto Rico, beyond the Puerto Rican Trench and as far north and west as 30°N and 70°W . Some effort was reported in the Mona Channel and Windward Passage as well immediately southeast of Puerto Rico.[86]

1992: Fishing was still reported around the Puerto Rican coast. Only limited effort was reported in the Mona Channel, but considerable activity was reported in the Windward Passage. Fishing in the Atlantic northeast of the island was less concentrated.[87]

1993: Less fishing was

Photo 12.--The commercial longliners operated by mainland fishermen have the range to move back and forth from the mainland and well out into the Atlantic. Julio Serano

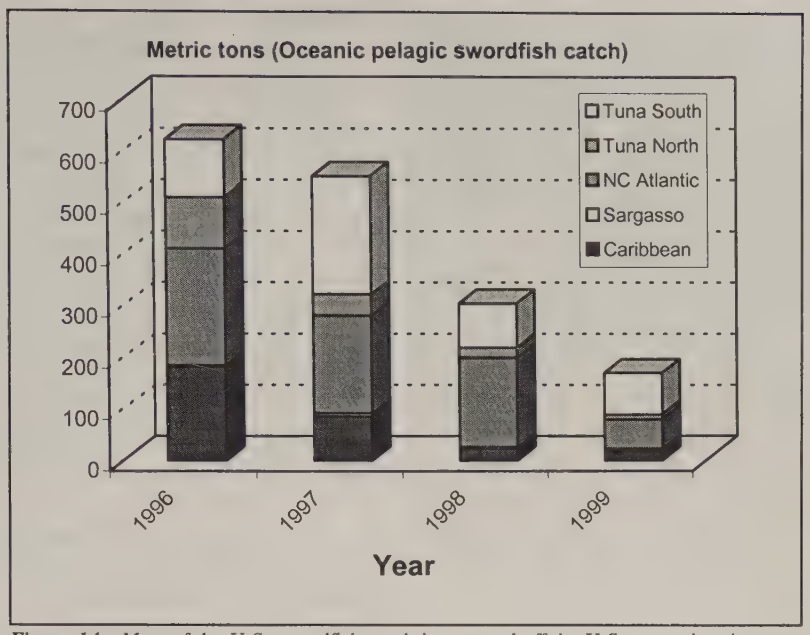

Figure 14.--Most of the U.S. swordfish catch is reported off the U.S. coast, but there are catches reported in the Caribbean and other off-shore areas as well.

reported close to Puerto Rico in 1993. Some fishermen ventured further out in to the Atlantic east of Puerto Rico. Effort in the Mona Channel was minimal, but considerable in the Windward Passage.[88]

1994: The fishery along the southern coast of Puerto Rico, especially to the southeast, intensified in 1994. Somewhat less effort was noted to the north and east). There was still only limited effort reported in the Mona Channel and effort in the Windward Passage slackened somewhat.[89]

1995: Fishing effort increased to relatively high levels in 1995 (appendix A2b). Most of the fishing close to Puerto Rico was reported to the south and southeast within the Antillean Arc. Minimal fishing was reported in the Mona Channel and fishing in the Windward Passage slackened. Much of the fishing out of San Juan occurred beyond the Antillean Arc, east of the Lesser Antilles, but mostly west of 45°W.[90]

1996: Swordfish catches were widely dispersed in 1996. More fishing was reported close to Puerto Rico in 1996, including some limited activity in the Mona Channel, although the Windward Passage continued to be more important. The primary ground for longliners based in San Juan continued to be beyond the Antillian Arc in the north central Atlantic to the east of the Lesser Antilles. Fishermen moved further south and east than ever before. Notable activity was reported as far south as the Equator and as far east as 35°W.[91]

1997: Fishing effort dropped in 1997 (appendix A2b), but fishermen continued setting south of Puerto Rico in 1997. While that was only limited fishing in the Mona Channel, intensive effort was reported in the Windward Passage. Extensive but scattered effort continued in the Atlantic east and south of the Lesser Antilles.[92] Swordfish catches during 1997 were primarily from the Atlantic statistical areas ("north central Atlantic" and "tuna south") (appendix D3c).

1998: Effort out of San Juan declined to only low levels in 1998 (appendix A2b). The general fishing pattern in the wider-Caribbean, however, changed little, with the exception that there was much less fishing immediately around Puerto Rico itself.[93] The swordfish catch also declined in 1998. Catches were mostly from the "north central Atlantic" and "tuna south" statistical areas (appendix D3c).

1999: Effort declined further in 1999 to very low levels (appendix A2b). There was little fishing within the Caribbean basin generally in 1999 and almost none around Puerto Rico itself. Fishing in the Windward Passage also declined.[94] The major fishing areas continued to be the "north central Atlantic" and "tuna south" statistical areas (appendix D3c).

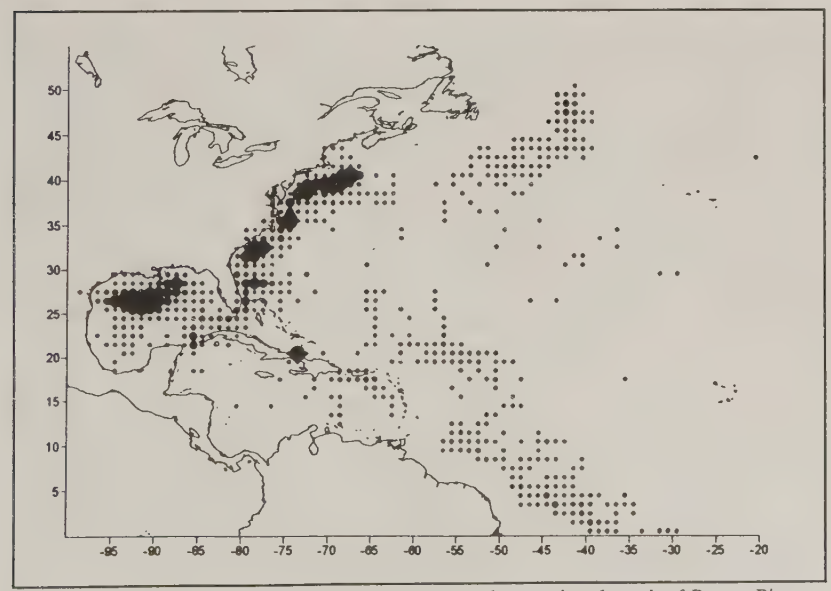

Figure 15.--Longlining out of San Juan was reported around and south of Puerto Rico, as well as the Windward Passage and east and south of the Lesser Antilles. Cramer and Adams

Photo 13.--Puerto Rican fishermen operate a large number of small boats. The most common boat type are open "yolas". William Folsom

IV. Fleet

A. Domestic vessels

The domestic Puerto Rican fishing fleet is primarily an artisanal fleet of small boats targeting inshore coastal grounds.

1) Artisanal

Puerto Rican has one of the largest artisanal fleets in the Caribbean. The fleet appears to have increased about 50 percent since the 1970s, but fleet estimates vary somewhat.

1970s: One excellent, but now dated study of the fleet in the late 1970s reported an artisanal fleet composed of about 1,000 boats, about 90 percent of which were only 4.0-6.5 meters (m) in length (appendix A1).

1980s: Another report indicated that about 1,100 boats were deployed in 1988, mostly less than 6 m with 25 horsepower (hp) outboard motors.[95]

1990s: Puerto Rican sources have provided varying fleet estimates during the 1990s. The Departamento de Recursos Naturales y Ambientales (DRNA) reports that as of 1995 the artisanal fishermen continue to operate about 1,000 boats.[96] A Commonwealth Department of Agriculture (PR-DA) official also estimates that there are about 1,000 boats, about 90 percent of which are about 9-m long. About 5 percent are larger vessels up to about 16 meters.[97] Another knowledgeable local observer, however, estimates that the number of boats actively utilized by full-time artisanal fishermen may be as high as 1,500 boats.[98] This higher estimate is confirmed by a detailed census carried out by the Laboratorio de Investigaciones Pesqueras in 1995-96. They reported over 1,500 fishing vessels with over 60 percent in the 5.0-6.5 m class. About 1,200 motors were reported averaging 43 horsepower.[99]

The apparent increase in the number of fishing vessels since 1998 is, in part, a reflection of Commonwealth Government promotional efforts. The Puerto Rico Department of Agriculture in 1992 initiated the Fisheries Loan and Incentive Program. This program, as well as rising fish prices, has allowed more fishermen than ever before to own their own boats. The number of motors was less than the number of boats. Some fishermen may be using one motor for two or more boats.[100]

Puerto Rican fishermen primarily deploy two types of artisanal boats, yolas and petreles. Most are in 5-9 m long. A few are as large as 9-12 m which are mostly deployed off the western coast.[101]

Yolas: The most common artisanal vessels are still the traditional "yolas," small (averaging about 5.0-5.5 m) open wooden boats with outboard motors. A few of these vessels, usually the larger yolas, are made of fiberglass-coated plywood. The authors believe that fishermen since the 1970s have gradually increased the size of the boats and power of the outboard motors used. Some fishermen now operate 6-7 m yolas, but few are larger than 7.5 meters.[102] No current statistical data is available on the number of yolas, but probably is comparable to the total number of artisanal boats described above.

Petreles: Petreles are also open boats, but are somewhat longer (generally about 7 m) and have higher sides than the traditional yolas. The petreles are constructed from fiberglass and the larger size allows the fishermen to operate more safely in rougher conditions as well as to make longer trips. No information is available on the number of petreles, but they are believed to still represent a relatively small part of the overall artisanal fleet.

Quite a number of small boats are still used in a handline fishery. NMFS in 2001 issued 110 general permits for tuna (appendix A5). These vessels can use handlines, rod and reels, and harpoons. They vary from 4-20 m, but most are in the 5-7 m range, mostly wood and fiberglass (GRP). Most of the boats are based in Aguada, Aguadilla, and Rincón, along Puerto Rico's northwestern coast.

Puerto Rican fishermen generally operate their small boats with very limited crews. Some fishermen go out by themselves or take a friend along. Boats of only 5-7 m usually are operated by the owner and a one person crew.[103] One fisherman with a 10-m boat reports a crew of three. A few boats carry crews of up to four men.[104] Often in the small-scale Puerto Rican fishery, the crew and boat owners are friends.[105]

Puerto Rican artisanal fishermen do not target swordfish with their small boats, although they have occasionally taken a few. They did land billfish, especially marlin until U.S. fishing regulations prohibited the marketing of billfish, reserving it for the recreational fishery.

2) Commercial

Puerto Rican fishermen have not traditionally deployed commercial fishing vessels. The largest vessels deployed by domestic fishermen have been a few general-purpose decked vessels which have deployed multiple gears, including handlines and to a lesser extent gillnets. The largest fishing vessels deployed by Puerto Rican fishermen are 15-16 m, but only a few such vessels have been deployed. The Puerto Rican Commonwealth Government in recent years has acquired several larger fiberglass boats (9-16 m) which it leases to various fishermen for minimal fees ("usufructo").[106]

A few fishermen in recent years have acquired a small number of commercial vessels varying in length from 15-21 meters. Some of the fishermen involved apparently experimented with small longlines, although the authors have received widely varying accounts on this. The authors have noted different estimates on the number of these vessels. One source estimated about five such vessels.[107] Another thought there might be two or three.[108] One researcher in the mid 1990s reports seeing two boats with small longlines, but they only operated for a few months.[109] The vessels involved appear to have been multi-purpose boats with small longlines. The fishermen used various gear to take lobster, conch, and yellowfin and bigeye tunas as well as sharks incidentally. One report indicated that they were based in San Juan.[110] They did not fish on the highseas like the U.S. based longliners, but on grounds closer to the island.[111]

Puerto Rican fishermen do not currently operate any longliners. The fishermen apparently have decided not to pursue longlining as they have not applied for or received NMFS swordfish or tuna longlining permits (appendices A3 and A5). There are apparently no longliners currently operated by Puerto Rican fishermen. One or two small longliners were reportedly active in the early 1990s, but there has been no known longline vessels operated by the domestic fishermen since 1995.[112] It is unclear why Puerto Rican fishermen have not deployed small longliners as has been done on several other Caribbean islands. One local researcher believes that overfishing and the local consumers preference for demersal species may be factors.[113]

Photo 14.--Puerto Rican fishermen have begun to replace their traditional "yolas" with fiberglass "petreles" like these built by the Rincón municipal government. William Folsom

Some controversy arose in Puerto Rico concerning the pelagic fishery in 1999. Fishermen needed NMFS permits to take tuna or swordfish both within and outsize the U.S. EEZ. There were no Puerto Rican longliners, but artisanal fishermen were taking tuna as well as some billfish which was totally prohibited. Unconfirmed reports suggest that some fishermen were landing substantial quantities of illegal fish monthly.[114] The species composition of the fish is

unknown but probably included tuna and billfish as well as an occasional swordfish. Most of this was apparently being sold to unlicensed dealers. Fines for such violations can range from $1,500 to $10,000, depending on the severity of the violation.[115] Many Puerto Rican artisanal fishermen were unaware of the regulations. Many did not speak English which somewhat complicated informing them of the permit requirements. Intensified efforts helped inform the fishermen of the regulations. The authors note that in 2000 and 2001 many artisanal fishermen have successfully obtained general tuna permits (appendix A5). Thus their tuna catches using handlines/trolls are now legal--although no billfish or swordfish landings are possible with only tuna permits. Many of the fishermen who have tuna permits, however, report only minor tuna catches.[116]

3) Recreational

Puerto Rico has a massive fleet of recreational boats. The Puerto Rican and Virgin Islands fleets may well exceed that of all the other Caribbean islands combined. Estimates concerning the number of recreational boats in Puerto Rico vary widely. Observers report that the recreational fleet has expanded significantly in recent years. One 1989 study estimated that there were nearly 44,000 boats, 10,000 more than in 1984. The study indicated that even though the industry was expanding rapidly, services and facilities for recreational fishing were inadequate to meet the growing demand. One source complained that services for recreational fishermen were in some cases disorganized.[117] A Caribbean Fisheries Management Council (CFMC) official thought that there may be 55,000 recreational boats on Puerto Rico which are at least occasionally used for fishing and up to 2,000 commercial (meaning mostly small artisanal) boats.[118] The best available statistics are compiled by the Departamento de Recursos Naturales y Ambientales/ Department of Natural and Environmental Resources (DRNA). There is a requirement to register recreational boats in Puerto Rico. This is done at the Boating Commissioner's Office which is part of DRNA. The DRNA reports that in 2000 that there were 52,100 registered boats of which the immense majority were recreational. Jet skis (PWCs) are the fastest growing segment of the vessels registered.[119] Puerto Rican officials in 1996 estimated that about 5,000 recreational fishing vessels are rigged for pelagic species. About 1,000 of these vessels are reportedly used frequently.[120] Many of the recreational vessels are about 10-14 m fiberglass vessels, but there are vessels over 18 meters.

Puerto Rico clearly has the largest sport fishing fleet in the Caribbean. Vessels from Puerto Rico not only regularly participate in the many Puerto Rican tournaments, but often participate in the tournaments held on neighboring islands, especially the USVI and BVI, as well.[121] Because of the number and size of the vessels, sport fishermen in the BVI sometimes refer to Puerto Rico's recreational fleet as the "Puerto Rican Navy."[122] Typical boats available for charter include: 9-11 m Bertrams and 14-m Hatterases.

***Photo 15.**--Puerto Rico has a huge number of pleasure boats, of all sizes and categories. Many of these boats are rigged for recreational fishing, significantly adding to the commercial effort. William Folsom*

***Photo 16.**--The "Janice Ann" is one of the many U.S. mainland longliners that has fished for swordfish out of San Juan. Many of the U.S. longliners working out of San Juan are larger. William Folsom*

B. Mainland U.S. vessels

The U.S. longliners participating in the Caribbean fishery are commercial vessels of varying sizes. Some of the largest U.S. longliners are deployed seasonally in the Caribbean, but there are also some relatively small longliners. One 1987 article estimated the vessels ranged from 15-26 m long.[123] One knowledgeable local observer in 1996 confirmed the shift to larger vessels and noted vessels varying from 22.5-28.5 meters.[124] Another observer described somewhat larger vessels, up to 30 m, confirming that the fishermen are gradually shifting to larger vessels.[125] Press reports, however, indicate that vessels of 21 m were still operating in the fishery during 1999.[126] The authors have observed vessels ranging from about 13-30 meters. The Gallamore vessels are some of the larger longliners deployed in the fishery and were about 30 m long. Many of the vessels are fiberglass, but the larger ones tend to have steel hulls. The larger vessels have holds with capacities of about 35 tons.[127] Most carry a crew of five or six, including the master and are equipped with sophisticated navigational, communications, and fish finding electronic instruments.[128]

A few U.S. mainland fishermen during the 1980s began operating commercial swordfish longliners from San Juan on a seasonal basis. The number may have been as high as 70 longliners, but has varied widely. Usually about 20 vessels were involved (appendix A2a-b). During the 1990s, the fishery peaked with 33 mainland longliners participating in 1995. A few of these vessels have been homeported in San Juan. The number actually based in Puerto Rico, however, has been very limited and none have been home-ported in Puerto Rico since 1987 (appendix A3).

The number of longliners active out of San Juan has varied over the years, but since 1987 has declined sharply. The masters have returned to the U.S. mainland and some have even deployed in Pacific fisheries. Only about 9 mainland longliners were active in Puerto Rico during 1999 (appendix A2a-b). This is a sharp decline from 1997 when 26 longliners operated from San Juan. One report indicated that as of June 2001, only 4 mainland longliners has operated out of San Juan.[129]

The commercial swordfish fishery is highly seasonal. There are annual variations, but the general pattern is relatively constant.

Caribbean: The mainland longline fishermen are active in Puerto Rico from late November to June.[130]

Mainland: The mainland swordfish fishery moves north up the coast as the year progresses. The first catches of the year are reported in the Gulf of Mexico and eastern coast of Florida. The best catches in this southerly area of the mainland fishery are reported during February and March, but sometimes as late as May. The bulk of the catch is reported off New England with good results beginning in July. The best catches are reported from August to November (United States, appendices A1-3).

V. Shipyards

There are no major shipyards in Puerto Rico building commercial fishing vessels. The vessels deployed by the artisanal fishermen were almost all built on the island. Most of the traditional wooden yolas that dominate the artisanal fleet are built by local shipwrights, although this activity is declining. At least one company builds fiberglass boats, but produces mostly recreational vessels.

Puerto Rico has quite a large network of yards offering maintenance and repair services. The largest yard is located in San Juan and has dry dock facilities for vessels of up to 37 meters. Other smaller yards are located in Arecibo, Cataño (near San Juan), Fajardo (Papo Araña). These facilities primarily service the large Puerto Rican recreational fleet, but also provide services to larger boats, including the U.S. mainland longliners.[131]

A. Artisanal boats

Puerto Rico's traditional wooden yolas are almost all built on the island. The yolas are largely built by local shipwrights specialized in small boat construction. Some of the smaller wooden yolas have been built by the fishermen themselves. Larger fiberglass-coated wood vessels and fiberglass-hull vessels, such as the petreles, are also constructed locally. One yard located on the eastern coast at Maonabo south of Fajardo builds fiberglass boats. Their work, however, is primarily recreational boats.[132]

Most of the island's larger fishing vessels have been imported, primarily from the U.S. mainland. The 9-16 m fiberglass vessels that the Commonwealth Government leases to the artisanal fishermen' groups, for example, were all built in mainland U.S. shipyards.[133]

B. Mainland U.S. longliners

The longliners deployed by mainland U.S. fishermen have been brought to Puerto Rico by mainland U.S. fishermen and were built in mainland U.S. shipyards.[134] The U.S. mainland fishermen use Puerto Rican yards for maintenance and repairs, although extensive work on their longliners involving drydocking is usually done on the mainland.[135]

VI. Fleet Operations and Gear

A. Domestic fishermen

1) Artisanal fishery

Puerto Rican fishermen conduct essentially an artisanal fishery. Puerto Rican officials report that during the 1980s about 1,500 artisanal fishermen were active.[136] A more recent report estimates that approximately 2,000 artisanal fishermen were active during 1995, about half of whom fished full-time.[137] The artisanal fishermen using yolas generally fish by themselves or in pairs. The full-time fishermen report only modest income from their endeavors. Many are older individuals and the modest earnings from artisanal fishing is attracting few younger workers. The high rate of unemployment on the island, however, forces many to pursue artisanal fishing because of the limited available alternatives. The part-time fishermen often fish only during the weekend or on a seasonal

Photo 17.--Puerto Rican fishermen set large numbers of traps. There are currently no limit on the numbers set. Julio Serano

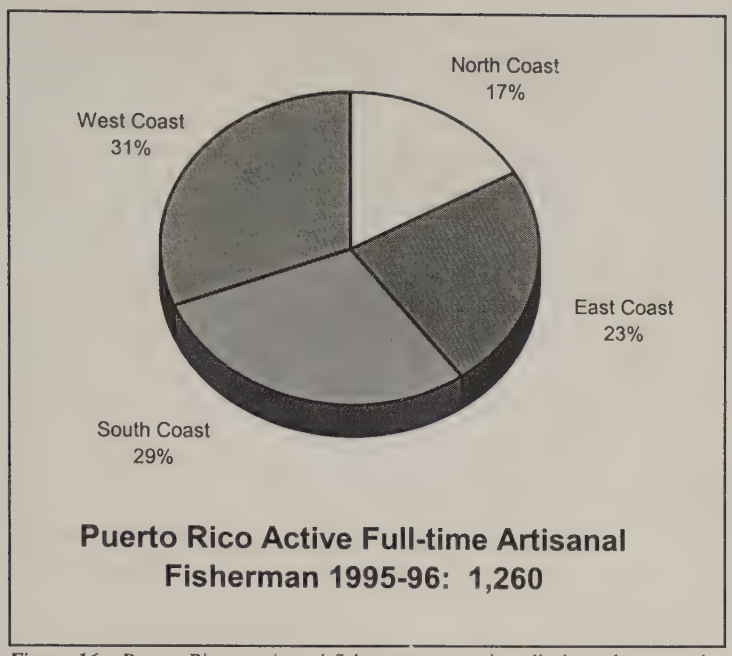

Figure 16.--Puerto Rican artisanal fishermen are active all along the coast, but primarily along the western and southern coasts.

basis.

Artisanal fishermen, given the multi-species nature of the fishery, use a variety of gear. Tropical waters in general are very diverse in both habitat and species. The large commercial fisheries using highly specialized gear and vessels practiced in the north Atlantic are not viable in tropical Caribbean waters. Traditionally, the most common gear has been traps, but the use of other gear has increased in recent years (appendix C3a). Many trap fishermen, apparently disappointed by declining trap yields and other problems, have shifted from traps to various alternate gear.[138] The fishermen are increasing the use of different types of lines, especially hook-and-line gear.[139] Traditional traps and hook/lines now account for over 70 percent of the total Puerto Rican fisheries catch (appendix C3c).

Trap fisheries: Puerto Rican trap fishermen primarily target reef fish and lobster.[140] The most important species taken are snappers, grunts, and groupers as well as lobsters. Over half of the Puerto Rican catch has traditionally been taken with traps. Trap fisheries (Antillean and arrowhead types) predominate along most of the Puerto Rican coast, except for the northern coast.[141] Fishermen have reduced the use of traps in recent years primarily because of the high cost of replacing traps that have either been stolen or lost due to rough weather.[142] Other observers have reported steadily declining trap yields.[143] The trap catch appears to have declined, but somewhat dated available sources provide a somewhat confusing pattern (appendices C3a-c). Officials point out that yields in the trap fishery are very low. Yields are in fact only a fraction of what Bermuda fishermen were reporting when traps were banned there in 1990.[144] Detailed regulations on traps are included in the 2001 proposed regulations, but there is no limit on the number of traps. A recent study using Global Positioning System (GPS) technology assessed fish traps on Puerto Rico's southwestern shelf.[145]

Net fisheries: The most commonly used nets are beach seines and gillnets, but some trammel nets are also deployed. The largest fish appear to be taken in gillnets, followed by trammel nets and beach seines.[146] An analysis of the Puerto Rican net fisheries (mostly beach seines and gillnets) show that swordfish are not taken in any appreciable numbers.[147]

Photo 18.--Artisanal fishermen deploy a variety of nets. The usage of nets, especially monofilament nets has been increasing in recent years. Julio Serano

Beach seines: Beach seines ("chinchorros") are constructed of two wings of mesh webbing and a bag. Mesh sizes range from 2.5-15.4 centimeters (cm) along the southern coast and 1.3-30.5 cm along the western coast. Common species harvested include grunts, snappers, and jacks.[148]

Gillnets: A variety of gillnets ("trasmallos") are in use,

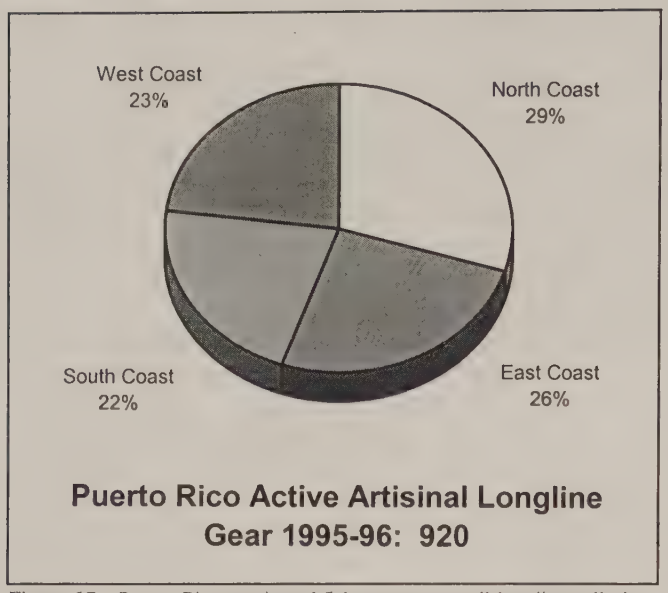

Figure 17.--Puerto Rican artisanal fishermen set small longlines all along the coast. The primary target is a variety of demersal species. Some sharks are also taken.

including ones suspended at the surface, and anchored at the bottom. Mesh sizes range from 2.5-10.2 cm along the southern coast and 1.3-10.2 cm along the western coast. Although gillnets are commonly deployed for pelagic species, Puerto Rican fishermen often deploy them near reefs or on the bottom, resulting in substantial demersal catches.[149] Common species harvested include parrotfish, grunts, and snappers.[150] The use of gillnets increased during the 1980s.[151] Some observers are increasingly concerned about the expanding use of gillnets.[152]

Trammel nets: Trammel nets ("mayorquines") are constructed of three net curtains, suspended from a single cork line and a common lead line. The inside curtain uses a smaller webbing than the outside curtains. Mesh sizes along the southern coast range from 5.1-17.8 cm and along the western coast from 1.3-30.5 centimeters. Common species harvested include parrotfish, grunts, snappers, and jacks.[153]

Hook and line: Fishermen during the 1980s and 1990s have significantly increased the use of hook and line hand gear.[154] They take snappers, groupers, and a variety of other reef species, but may infrequently take pelagic species as well. Some of these fishermen, once off shallow water appear to pursue troll fisheries, loosely defined as they may deploy troll lines as they move between grounds. Thus they sometimes report dorado catches as well.[155] Many fishermen employ 1 or occasionally 2 crew members to help on their small boats. Some larger boats may have 3 fishermen. Typical operations are day trips which may involve leaving about 6:00 am and returning to port about 4:00-5:00 pm.[156] These operations vary widely. One fisherman reports leaving at 4 am.[157] Other fishermen may leave in the afternoon about 2:00 pm and come back in the early morning.[158] A few fishermen may take 1-2 day trips.[159] There is a great range in the number of trips per week, which of course is affected by the weather.[160] Some fishermen may make about trips per week, while others only 1 or 2 trips.[161] They may operate up to about 5-25 km off shore, but some fishermen may go out as far as 40 km. A typical small-boat (5-7 m) catch is about 15 kg per trip, a few report catches over 20 kg per trip. Larger boats (10 m) report 20-40 kilograms. Some fishermen report operations all year round while other report seasonal operations.[162]

Bottom line: Bottom lines are one of the principal gear employed along the northern coast. Very small quantities of swordfish are occasionally taken using bottom lines. Fishermen in 1988, for example, reported swordfish landings totaling 2.3 tons.[163]

Longlines: A few artisanal fishermen deploy small longline or trot lines ("palangres") (appendix 3b). These are very small demersal longlines, about 400 m in length. Longlining ia a small part of the Island's

Photo 19.--Beach seines are one of the several types of nets set from small boats all along the Puerto Rican coast. William Folsom

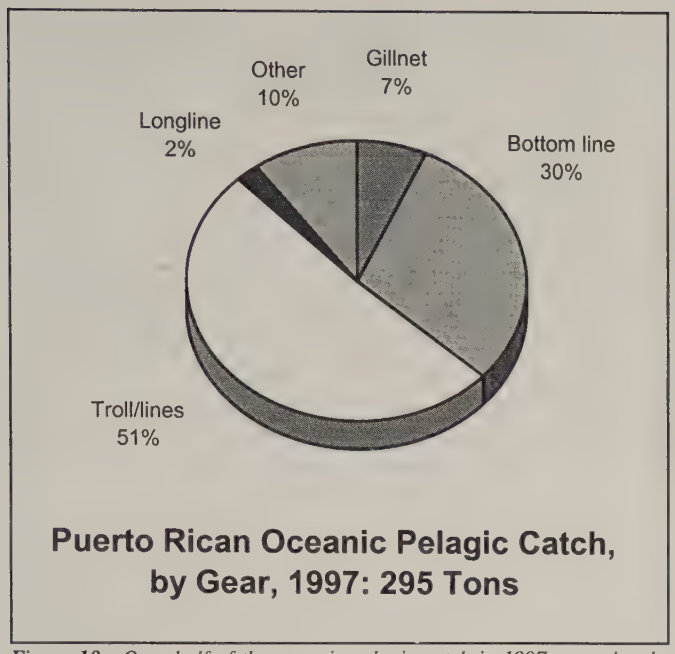

Figure 18.--Over half of the oceanic pelagic catch in 1997 was taken by trolls and similar lines. The trolls took mostly tuna and dorado.

overall fishery. These fishermen land only about 1 percent of Puerto Rico's small catch.[164] The fishermen have traditionally taken a variety of species, especially lane and mutton snappers.[165] Another report indicates that sharks are taken around La Parguera along the southwest coast.[166] New NMFS regulations now require a permit for taking tunas and sharks and none have been issued for longlining (appendix A5). The authors have attempted to obtain additional details on the artisanal longliners, but

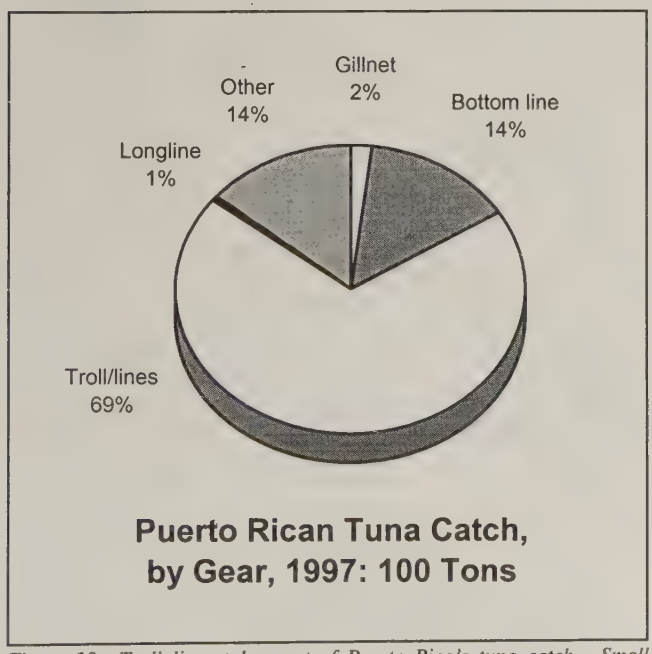

Figure 19.--Troll lines take most of Puerto Rico's tuna catch. Small quantities are reportedly taken by bottomlines, but this probably includes gear that are not always set on the bottom.

apparently is a very small operation and many of the local observers interviewed had no information on it. The artisanal fishermen deploying longlines primarily target shark, but occasionally report small swordfish catches as well. Fishermen in 1988, for example, caught 5.1 t of shark and 0.9 t of swordfish.[167] Subsequent reports do not mention swordfish and indicate that most of the shark was taken with bottom lines.[168] Little information is available on the boats used, but the lines are apparently deployed from the small yolas. There are currently no commercial Puerto Rican longliners.[169] One Puerto Rican did acquire a longliner in the early 1990s, but he was reportedly arrested on cocaine charges in 1992 and the vessel was confiscated. Another source indicates that a 13-m artisanal vessel was deploying a longline in 1994, but that was the last known domestic longline operation.[170]

Hand/troll lines: Some exploratory surveys and gear tests assessing the use of troll gear were conducted by Puerto Rican researchers during the 1970s.[171] Some fishermen have since adopted troll lines ("silgas") and now target dorado, tunas, and other pelagics. Observers indicate that these fishermen are based and operate mostly along the northwestern coast where the shelf is narrow and deepwater can be found close to the coast. The authors noted 110 Puerto Rican fishermen with general tuna permits (appendix E2b). Most of these fishermen will be using troll/hand line gear. In reviewing Puerto Rican reports some authors may refer to the gear as hand lines.[172] Other as troll lines.[173] In fact the methods used are a kind of combined handline/troll line approach. It is not possible to anchor in deepwater. So the fishermen drift as they deploy handlines. In addition other fishermen moving to and from fishing grounds may pull a line or two behind them. The vessels used often do not have sleek lines or powerful outboards, so the approach is somewhat different than generally thought of by the term troll. The fishermen involved may also set a few traps or even use rod and reels as well.[174] The Puerto Rican catch of oceanic pelagics is primarily taken with fishermen using this handline/troll approach. The fishermen mostly make daytrips, fishing for just a few hours. Fishing patterns can vary, fishermen leave both in the morning from 4:00-6:00 am and in the afternoon about 4:00 pm and make trips of anywhere from 4-12 hours. Many fish about 8-10 km off shore, but some report operating as far as 25-50 km or more off the coast. This depends on the species being targeted.[175] Fishermen vary as to the number of trips per week. Some part-timers may make only 1-2 trips which full-time may make 4-5 trips.[176] Most of the dorado, as well as much of the tuna and marlin,

Photo 20.--Artisanal fishermen like this Rincón fishermen can deploy various gear, including hand/troll lines for pelagics. William Folsom

has historically been taken by troll gear (appendix D2a). One report indicates that all of the commercial dorado and 90 percent of the tuna and mackerel, and 75 percent of the barracuda catches are taken by troll lines.[177] The troll fishery is concentrated along the northern coast, in part because deepwater is so close that it is within the range of small the small boats used by the fishermen. Many fishermen use a local bait species--"chicharras". Sardines, ballyhoo, and squid are also used.[178] The fishermen may take tunas as close as 3-4 km off shore, but seasonally may move as far as 40 km out from the coast to take dorado and wahoo.[179] Large species like billfish were more likely to be a bycatch for these fishermen who primarily target tunas on a seasonal basis. Taking a billfish appears to have been a rare, but welcomed event for this fishermen. An occasional billfish, especially blue marlin, are more likely to be taken than swordfish.[180] Landing billfish is now illegal, but it is really frustrating for a small-scale fishermen to discard such a big fish. As a result, such landings do occur.[181] One observer reports that small boat fishermen from scattered locations along the northeastern coast such as Crash Boat Beach (Playa Boquerón Sur) during 1990 were taking swordfish.[182] A researcher working with the fishermen for many years has never seen a swordfish being landed, although the fishermen have mentioned a few.[183] Another observer reports that while few swordfish are taken by these fishermen, there are occasional landings.[184] The fact that these fishermen operate during the day very close to the coast, considerably reduces the chances that they will encounter swordfish. Other species taken include albacore, bonito, dorado, kingfish, and wahoo. The fishermen very rarely take swordfish with trolls, but they do report occasional marlin and other billfish catches.

Diving: Diving is also of some importance, mostly scuba diving for queen conch and to a lesser extent finfish.

Harpoon: A few Puerto Rican fishermen along the northwestern coast have obtained tuna harpooning permits (appendix A5). The authors have no details on actual harpoon fishing. Puerto Rican officials know of no artisanal harpooning, but speculate that some recreational spear fishermen may have applied for the permits.[185] The fishermen may have also applied for the permits in error.

Multiple-gear: Many artisanal fishermen use a variety of gear. Fishermen may use both drop lines and trolls to catch demersal fish like snappers and pelagic fish like tunas. They may also set a few traps for lobsters.[186]

Puerto Rico has only a small catch of oceanic pelagics. The catch was about 150 t in 1994. The fishermen do appear to be expanding the pelagic fishery and catches increased to 280 t in 1997 (appendix D2d). The fishery is highly variable, catches of only about 125 t were reported in 1992 and 1994. Puerto Rico's pelagic catch is primarily composed of tunas, dorado, and mackerels along with lesser quantities of shark. The fishery is somewhat unusual as only minimal quantities of the oceanic pelagics are taken by longline, they are mostly take by troll lines and rather unusually bottom lines (appendices D2e1-2). Other assessments show that the oceanic pelagic catch was almost all taken by troll lines (appendix D2a). Although the longline catch of pelagic species is very limited, there was some increase in the longline shark harvest during 1997 (appendix C2e2). Sharks are often taken with demersal longlines.

Artisanal fishermen deploying lines (handlines, trolls, or small longlines) may occasionally catch a billfish or swordfish. Federal regulations designed to better manage depleted billfish stocks prohibit the sale of billfish taken in the north Atlantic.[187] This limitation frustrates the artisanal fishermen. These

fishermen take several pelagic species, especially tunas (mostly yellowfin) and other species such as bonito and dorado. Very infrequently they may take a swordfish or billfish. A blue marlin, for example, could earn them $200-300--a substantial sum for these relatively low-income artisanal fishermen.[188] Puerto Rican hand-line fishermen claim that they take a billfish as infrequently as one every 5 years and swordfish even less frequently.[189] These fishermen have asked for special exemptions to the regulations because of the extremely small number of fish taken and the special artisanal character of the fishery.[190] Earlier regulations had attempted to accommodate their concerns as long as it did not compromise efforts to rebuild the depleted stocks.[191] Special exceptions were made for the artisanal fishermen. The exemptions for Puerto Rican artisanal fishermen were ended in 1999 with the new NMFS management plans for HMS (highly migratory species), including tuna, swordfish, sharks, and billfish.

Artisanal fishing boats are operated by both individual fishermen and fishermen's associations established by Community Action programs promoted by the Puerto Rican Department of Labor. A island-wide Congreso de Pescadores supports the individual associations.[192] Many fishing centers/communities have their own associations. The Agriculture Development Corporation and the Agricultural Credit Corporation provided credits during the 1970s to help artisanal fishermen purchase modern fishing boats. The boats purchased under the program were fiberglass craft. The first such boats ranged from 7.5-15.5 m in length and were equipped with refrigerated or insulated ice boxes to hold the catch, and instruments and gear including compasses, radios, echosounders, and hydraulic reels.[193] These modern boats significantly increased the range of the fishermen, allowing them to expand somewhat beyond the most-heavily fished inshore waters. The Commonwealth Government continues to own the boats and leases them to the fishermen. The local government in some municipalities have also assisted fishermen by acquiring new, larger vessels and leasing them at modest rates. The municipal government of Rincón, for example, recently acquired six new fiberglass fishing vessels (petreles) which they are leasing to fishermen's groups for very modest fees ("usufructo").[194]

Photo 21.--Recreational fishing is a popular activity for Puerto Ricans of all ages. William Folsom

Artisanal fishermen report varying patterns as to how they sell their catch. Many sell through the fishermen's associations to which they belong. Some try to sell their catch themselves. Part-time fishermen often fish primarily for subsistence.[195] Others may sell small amounts to friends and neighbors.

Puerto Rican officials report that because the domestic fishery is essentially artisanal, using small inshore vessels and gear, there is virtually no Puerto Rican swordfish catch.[196] One official reports that since 1990 he has not noted one swordfish.[197]

2) Recreational fishery

Marine recreational fishing is an important industry in Puerto Rico and angling is a popular recreational activity. It is also an important attraction for the islands growing tourist industry. Anglers began developing the recreational fishery in Puerto Rico during the early 1950s. Much of the early interest focused on billfish.[198] The recreational fishery still relies on billfish to a greater extent than recreational fisheries in the mainland United States. While there is also some recreational fisheries for dorado and wahoo, there is very limited effort on demersal reef fish.[199] One 1989 report indicated that there were 18 marine sport fishing clubs in Puerto Rico, most of which sponsor tournaments.[200] The DRNA reports that in 1998 there were 46,000 recreational boats. One study

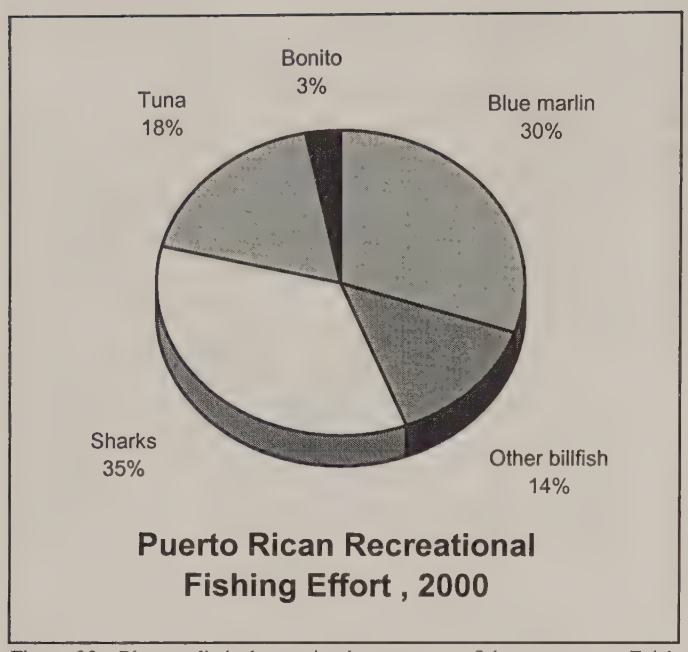

Figure 20.--Blue marlin is the species that most sport fishermen target. Fairly large number of sharks are taken by the anglers.

suggests that the recreational fishermen take more fish than the artisanal and commercial fishermen.[201]

Researchers in Puerto Rico have compiled a substantial amount of information on the island's recreational fishery. Collecting data on recreational fishing is an especially difficult undertaking. There are large number of anglers, many more than commercial or artisanal fishermen. The anglers operate a large number of boats, landing their catch at sites all over the island. Fishing also takes place from even more shore sites. Despite the difficulties associated with collecting data, information on recreational fishing is very important. As the total quantity of fish taken by anglers is substantial, in some cases larger than that of commercial and artisanal fishermen, an estimate of recreational fishing effort and catches is needed by fishery managers. Several groups in recent years have been working on the recreational fishery

Commonwealth: The Commonwealth Government last collected statistics on recreational fishing in 1989. Some Commonwealth Officials believe that this was a serious lapse.[202] The Commonwealth Government in 1999 initiated a new plan to collect data and to better regulate the recreational fishery.[203] Preliminary results suggest that there are over 80,000 marine recreational fishermen on Puerto Rico. There are about 14 charter boats companies (appendix A6a).[204] NMFS tuna permits have been issued to 9 charter boats, 5 of which are located at San Juan (appendix A5).

NMFS: The National Marine Fisheries Service (NMFS) since 1979 has conducted the Marine Recreational Fishery Statistics Survey (MRFSS) in the United States. Puerto Rico was included in 1979, but sampling there was discontinued due to budget constraints. In January 2000, the MRFSS resumed data collection in Puerto Rico. The sampling is being conducted by ORC Macro, an international survey research firm, in conjunction with the Puerto Rico DRNA. Personnel from the cooperating entities are collecting data at 113 access sites distributed among shore, boat ramps, marinas, and for-hire charter sites. Puerto Rico agency personnel and interviewers hired by the contractor are contributing their experience and knowledge of the local recreational fisheries to maximize the efficiency of the survey. Nearly 3,000 field surveys were conducted in Puerto Rico during 2000 to determine catch rate information and non-resident fishing effort. In addition, over 12,000 telephone household surveys were conducted to determine resident fishing effort.[205] The MRFSS estimates that more than 220,000 anglers took over 1.2 million recreational saltwater fishing trips in Puerto Rico in 2000. These trips are approximately evenly distributed between inland and ocean trips. Private boat fishing is much more prevalent than charter boat fishing. Fishing within 10 miles[206] of shore is common throughout the year, but effort in somewhat lower from January through April. In contrast, outside of 10 miles where much of the billfish and other pelagics are taken, fishing is most intense from November through April (appendix D4b). The most important billfish taken off Puerto Rico is blue

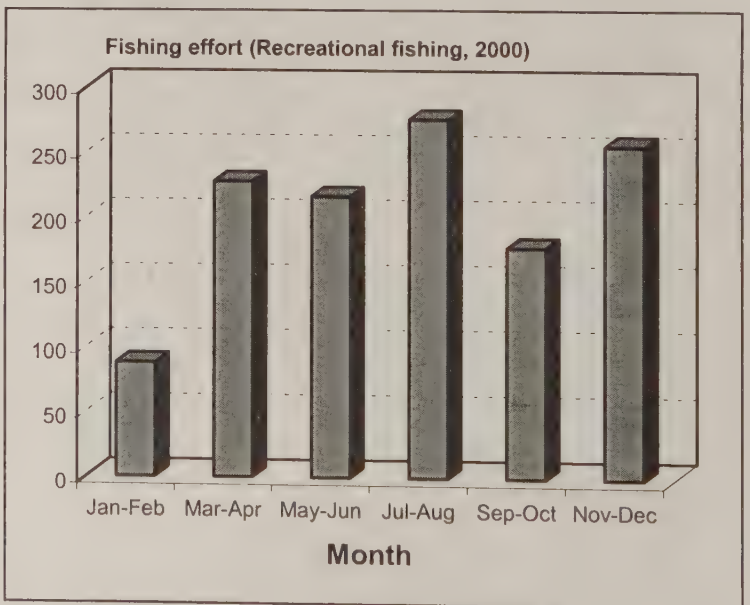

Figure 21.--Recreational angling is conducted throughout the year, but declines substantially during the colder months at the beginning of the year.

marlin, but in 2000 even larger numbers of sharks were taken (appendix D4a). Tunas, especially albacore and skipjack are also taken in quantity. Anglers on the island in 2000 reported over 1.2 millions trips annually (appendix D4b). Most of the recreational fishing in Puerto Rico is reported inland. The marine recreational fishing is largely conducted from private or rental boats. Fishing within 10 miles is active all year round, but lower during the first four months of the year. In contrast, outside 10 miles where much of the billfish and other oceanic pelagics are taken, fishing is most intense from November through April (appendix D4b).

Texas A&M: Researchers at Texas A&M have conducted information through a mail survey of anglers which provide an interesting overview of the recreational fishery for billfish. Most anglers are male and average about 40 years of age. The median income was relatively high, about $70,000-79,999. Over half have been saltwater fishing for 16 years or more. Most (82 percent) rated fishing as their most important outdoor activity. The preferred species targeted was blue marlin, but there was also considerable interest in dorado and sailfish. Puerto Rican resident anglers reported averaging 43 days of fishing annually. Most (79 percent) reported that someone in their household owned one or more boats averaging over 10 m in length. They felt that the most critical issues concerning sport fishing was commercial (including artisanal) fishermen followed by pollution and people not obeying laws/inadequate enforcement. They reported that on average, about 7 fishing days were required to boat a billfish. The anglers strongly preferred seasonal to area closures as a management tool. Nearly one third of anglers supported catch and release fishing. Another one-third were strongly opposed to it, indicating that they would stop fishing if catch and release fishing was implemented. Anglers were active in tournaments, but most of the fishing was not conducted as part of tournament fishing.[207]

Recreational fishermen off Puerto Rico particularly prize blue marlin. The all-time record for blue marlins in a single tournament was set by the Club Nautico de San Juan when 190 blue marlins were taken a decade ago.[208] The primary fishing technique used for billfish is trolling lines ("silga"). Very good sport fishing, especially for marlin, is located close to the island in an area known as "Blue Marlin Alley". Puerto Rico's narrow northern shelf means that it is only a short distance from shore before the shelf begins to fall off into the deeper water where billfish can be found. While blue marlin is the species most heavily promoted, some sports fishermen include swordfish on the list of species which they target.[209] The primary species most anglers want to hook continues to be blue marlin, but various other species are taken in these tournaments, including king mackerel and dorado. In addition to important pelagic species, Puerto Rican recreational fishermen also target inshore reef species.

The species taken vary at different locations along the coast. Along the northern coast, which locals refer to as the "Marlin Capital of the World," large blue marlins can be taken close to shore. Dorado fishing here is seasonally good. Both blue and white marlin can be taken off the western coast. Around Mona Island not only marlin, but dorado and wahoo are plentiful. Billfish are less abundant along the southern coast, but there are seasonal runs of dorado and wahoo. Catches in the shallow water along the east coast commonly include king mackerel and barracuda.

Photo 22.--The species most sports anglers would like to catch is a blue marlin and Puerto Rico is one of the best spots in the United States to take these magnificent fish. NMFS

The recreational fishing industry and Commonwealth Government officials are concerned about declining billfish catch rates. NMFS has established size limits on billfish, based on lower jaw fork length (LJFL) measures. The minimum sizes are: blue marlin (251 cm), white marlin (168 cm), and sailfish (160 cm).[210] These measures are designed to protect juveniles until they reach spawning sizes. There is considerable debate among scientists concerning the optimal

management measures. Some believe that it may be best to protect the large spawners. Some Commonwealth officials question the effectiveness of Federal regulations which prohibit the landing of juvenile. Some Puerto Rican officials are not convinced that this is the best management alternative and believe that the regulations are having a detrimental impact on stocks as they result in the landing primarily of female fish. (See: "XIII. Government Policy".) Recreational fishermen have, since the mainland longline fishery was initiated in 1984, objected to the mainland longline fishery because of the potential impact on billfish stocks. This concern has continued. DRNA officials reported complaints about longlining in the EEZ from the sports fishermen during public hearings on the proposed 2001 fishing regulations.[211]

Recreational fishermen in Puerto Rico organize about 25 local tournaments and one large international tournament annually. Most of these tournaments focus on the popular billfish, but they are other tournaments focusing on species like dorado as well.[212] The International Game Fish Association (IGFA) estimates that 15 blue marlin tournaments were held in 1999 alone.[213] Another source mentioned 20. The leading tournament is the Club Nautico de San Juan International Billfish Tournament which is usually held August/September.[214] It is one of the largest tournaments held in the Caribbean. Another important tournament is the Club Nautico Arecibo Sailfish Tournament, held on November 19-21, 1999.[215]

Club cooperation with management efforts vary. One NMFS enforcement agent reports that most club commodores seem to cooperate with the NMFS management effort. A small percentage, however, do not advise their members of HMS rules and regulations unless NMFS or DRNA agents are present during the registration phase before fishing actually begins.[216] Tag and release fishing is being increasingly adopted in Puerto Rico. It is not, however, as accepted as is the case among mainland anglers.[217] As on the mainland United States, catch and release was given great impetus by the no sale provision implemented by NMFS. The IGFA estimates that about 84 percent of the marlin taken in Puerto Rican tournaments are tagged and released.[218] Catch and release fishing, however, in charters outside of the tournaments do not conduct catch and release fishing as commonly as when they are participating in tournaments. Practices vary somewhat among the charter operators. Some charter companies make no mention of catch and release fishing. Other companies stress the importance of catch and release fishing. One company advises anglers, "Release them and they will grow on you."[219] Several other charter operators advertise catch and release fishing.

Not all of the tournaments or boat charters involve tag and release fishing. The charter head boats are in legal terms considered to be commercial vessels. Recreational fishermen can not sell their tuna catch, but charter boat operators can sell the catch if they have the required tuna permits (appendix A5). While Atlantic billfish can be taken by recreational fishermen without a license, the angler is not permitted to sell the catch. Recreational fishermen can not sell their tuna catch, but the captains of charter boats can if they have a permit (appendices A5 an A6a). Tunas can be sold to permitted dealers (appendix E2b). Some tunas, however, are also reportedly sold to dealers that do not have the needed permits. Swordfish can also not be sold by the recreational fishermen, but it is not a species which they normally take.[220] Billfish and tunas, however, are species the fishermen target. The charter boat fishermen offer full day excursions from about 8:00 am to about 4:00 pm. Anglers can also arrange half day excursions. Most of the boats take a maximum of about 6 anglers. The charter fishermen operating from San Juan claim that the fishing begins after only 20 minutes from the dock. Blue marlin is the preferred target species but dolphin, wahoo, sailfish, tuna, and white marlin are also taken.[221]

Recreational fishing is not without risk. A recreational fisherman in Puerto Rico on August 8, 1998 was killed when he got entangled with tackle while trying to boat a 317 kg blue marlin. His son almost died trying to save him. Some crew on a recreational boat carry a small razor knife around their neck as a safety precaution.[222]

One report suggests very good blue marlin fishing off the northern coast of Puerto Rico and the well known North Drop off St. Thomas (USVI) and Tortola (BVI).[223] Charter boats are available out of both Mayagüez, San Juan, and Fajardo. More than 20 billfish tournaments are held in Puerto Rico each year.[224] The actual number varies from year to year. Excellent catch rates have been reported at the Puerto Rican tournaments. An IGFA representative reported, for example, that at the 30th International Billfish Tournament held at San Juan during September, 1983, that 200 anglers on 64 boats caught 109 blue marlin and 1 spearfish. The biggest fish was a 220 kg blue marlin.[225] A Sea Grant research project in 1989 assessed the recreational fisheries in Puerto Rico and the Virgin Islands.[226]

Some observers report that the recreational fishery in Puerto Rico has not been well regulated. There have been virtually no Commonwealth

regulations on marine recreational fishing. The only exception has been for lobster.[227] There were no length or weight requirements for any fish, except lobster and species like billfish which are covered by Federal regulations. Puerto Rican sources report that the new administration of Governor Sila Maria Calderon has taken a noticeable interest in the environment and local observers report that the Commonwealth Government has adopted a new activist approach toward many environmental issues as well as the enforcement of environmental regulations. This has come at a time when the DRNA is about to implement the first comprehensive set of marine recreational fishing regulations.[228] The proposed DRNA recreational regulations will include a licensing program which they hope to have in place during 2001.

Some economists have attempted to assess the value of sport fishing to the Puerto Rican economy. A 1989 study estimated that sport fishermen spend about $2,600 per person annually in total outlays, including hotels and restaurants. The total impact on the economy at the time was as much as $25 million annually.[229] The economic impact has increased in recent years. Commonwealth officials in 1999 estimated that the recreational fishery for blue marlin alone appears to have brought over $40 million into the local economy.[230] A recent Texas A&M study found that the total economic impact of the recreational fishery for billfish was about $44 million.[231]

The economic impact of the recreational fishery is clearly considerable. Caribbean fishery managers often pursue policies that maximize the artisanal and/or commercial fisheries catch. Recreational fishing is often considered to be of minor importance. Some consider it a dalliance that should not be allowed to interfere with the production of food. Thus on some islands the fishermen are allowed, if not encouraged, to catch pelagic species like billfish to reduce pressure on heavily fished inshore domestic stocks. The fish is then sold fresh with virtually no value-added processing in local markets for relatively low prices, generally $4-8 per kilogram. The Puerto Rican example suggests that such policies capture only a fraction of the value from the available resource. In Puerto Rico, the value of the entire commercial (largely artisanal) fisheries catch is only about $8 million.[232] Thus the total economic impact of the capture fishing industry may be about $16 million, although this should be considered a very rough estimate.[233]

Surprisingly, the $16 million estimate of the economic impact of the capture fishery is only about one-third of the estimated impact of the billfish fishery alone--based on some of the estimates cited above. The authors were struck by the fact that the economic impact of the recreational fishery could be so much larger than that of the commercial and artisanal fishery and discussed this question with DRNA officials. The officials consulted believe that these estimates do indeed reflect the economic realities.[234] Extreme caution, however, should be used with these estimates. Many factors are involved in calculating economic impact and often they have not been calculated with precision. In many cases, researchers do not calculate "leakages" which in the case of the tourist industry in Puerto Rico and other Caribbean islands can be significant.[235] The Texas A&M researchers cited above did attempt to address such leakages by assigning a very low multiplier to the billfish sports fishery.

Despite the imprecision of available data, it is clear that the potential economic impact of recreational fisheries in the Caribbean is very substantial--perhaps greater than that of capture fisheries. The authors believe that the extent of this impact is not fully appreciated by many Caribbean fishery managers and political leaders.

Fishery managers: Puerto Rican fishery managers are well aware of the importance of the recreational fishery and have worked hard to gather data on the fishery. This is not the general case in the Caribbean. Caribbean fishery managers, as is the case in other regions, of course have to take into consideration many factors other than just economic impact. Economic impact studies often highlight the activities consuming the most resources. These might not be the best

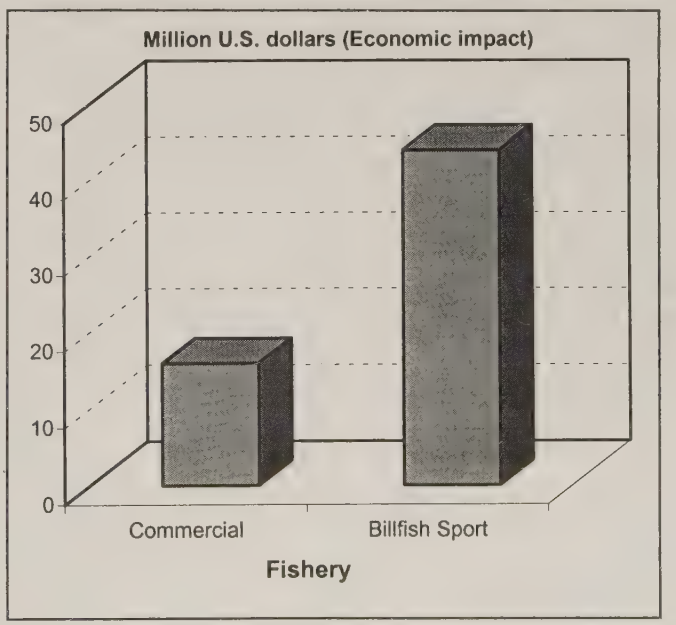

Figure 22.--Some economic studies suggest that the economic impact of the recreational billfish fishery exceeds that of the commercial fishery.

investments for a given economy.[236] One key factor is who benefits. Thus while the tourist sector may benefit from recreational fishing, artisanal fishermen in isolated coastal villages may be unaffected, or even harmed by competition for the available resource.[237]
Political leaders: Caribbean political leaders, except in Cuba, are democratically elected. Thus they are responsive to voter concerns. On most islands the number of full and part-time fishermen exceeds that of the local recreational fishermen. In many instances the fishermen are politically active and vocal. This contrasts to the United States where the number of anglers and their political influence in most states far exceeds that of the commercial fishery.

Definitive statements concerning the economic importance of the recreational fishery can not at this time be made. The authors believe that detailed studies fully assessing economic benefits in the Caribbean simply do not exist. The available information on Puerto Rico, while not definitive, is thought provoking and applicable to many other Caribbean islands. It does appear from available information that many Caribbean islands may not be obtaining the maximum potential benefit from their billfish resource as well as other stocks that are, or could be, targeted by recreational fishermen.

B. U.S. mainland fishermen

U.S. mainland fishermen have traditionally operated few vessels off Puerto Rico. Some U.S. mainland fishermen reportedly targeted snapper during the 1970s, but for the most part such activity was limited until the mainland fishermen became interested in swordfish. NMFS and the UPR research studies in the early 1980s demonstrated the availability of swordfish off Puerto Rico and the U.S. Virgin Islands. (See: "XIV. Research.") U.S. mainland fishermen began to deploy swordfish longliners during the mid-1980s. The first U.S. longline fishing for swordfish in the area was reported in 1983 when two U.S. longliners operated out of San Juan. The mainland U.S. fishermen have since deployed their vessels widely for swordfish and tuna operations in the Caribbean and western Atlantic. (See: "III. Grounds" and "VII. Catch".) Swordfish continues to be the principal species of interest, but the fishermen also target tuna.

Puerto Rico is the major landing point for the U.S. longline fishermen operating in the eastern Caribbean/western Atlantic. San Juan offers the advantages of a major international airport, with numerous daily flights to the mainland United States. The San Juan airport is the most important in the Caribbean. The frequent direct air connections with several mainland U.S. cities makes San Juan a highly desirable port for the fishermen who handle fresh product and need to arrange for the immediate shipment of their catch once it is landed. In addition, Puerto Rico is included within the U.S. Customs Area, facilitating easy access to the U.S. market.[238] The U.S. fishermen, by landing in Puerto Rico, are also able to avoid a number of possible difficulties associated with working out of foreign ports, including foreign language complications and foreign fishing, port, and customs regulations.

NMFS has collected data on the mainland longliners reporting operations out of San Juan since the fishery began in 1984. The data includes the number of vessels, trips, and size frequency data on the catch. Deployment has varied significantly from year to year and is highly seasonal. The number of longliners appears to have peaked at about 70 vessels in 1987-88 and has since declined. There was considerable activity in the mid 1990s, but by 1999 only 9 mainland longliners were operating out of San Juan (appendix A2a-b). Unconfirmed reports indicate that only 4 longliners have operated in 2001 through May. Available landings reflect the reduced fishing effort out of San Juan (appendix D3a). (See: "VII. Catch.")
1983: Following up on exploratory fishing conducted by NMFS and the UPR in 1982-83, the first mainland U.S. commercial longliners were deployed during 1983. (See: "XIV. Research.") Two South Carolina-based longliners (*Bobby Gail II* and the *Bobby Gail IV)* conducted trial fishing operations off Puerto Rico, the U.S. Virgin Islands (USVI), and the British Virgin Islands (BVI) during the winter of 1983. They confirmed the presence of commercial swordfish stocks.[239]
1984: Fishermen deployed the two original U.S. longliners and another 11-13 vessels from Florida and other east-coast mainland states. They primarily operated north of Puerto Rico, the USVI, and BVI, but some fishing was also reported south of the islands. The U.S. mainland fishermen in this first full-scale commercial effort reported excellent yields, especially north and east of Puerto Rico and the USVI.[240]
1985-86: The excellent results achieved in 1984 attracted many additional U.S. longline fishermen for the 1985-86 fishing season. One observer estimated at the beginning of the season that a large number (25-40) of mainland U.S. boats would be operating off Puerto Rico and the USVI in 1985-86. Apparently about 35 longliners were actually deployed in the fishery (appendix A2a).[241] Some of the fishermen were especially interested in grounds close to Puerto Rico and the USVI, especially BVI waters. About 12 of

Photo 23.--Many different mainland longliners have been involved in the swordfish fishery out of San Juan. They use the same gear and equipment as deployed off the U.S. coast. Julio Serano

those longliners reportedly obtained BVI fishing permits.[242]

1987-89: The swordfish fishery reportedly peaked during the 1987-88 season with as many as 70 longliners participated in the fishery (appendix A2a).[243] One San Juan press report indicated that 85 longliners were operating out of San Juan in 1987.[244] The authors can not confirm that as many as 70-85 mainland longliners were operating out of San Juan in 1987-88. NMFS records show 32 mainland longliners in 1987 and 25 in 1988. NMFS statisticians believe that by 1987 and 88 that their data included reports from virtually all the active vessels. Earlier reporting was voluntary and thus probably understated effort.[245] Catches had begun to decline after the 1986-87 season. (See "VII. Catches.") Thus after the disappointing 1987-88 season, many mainland fishermen decided not to return to the Caribbean. Most of the U.S. which did continue Caribbean operations only fished seasonally from San Juan. A few stayed and fished year-round out of Puerto Rico (four longliners) and the USVI-St. Croix (three longliners) (appendix A2a).[246] Landings reached very low levels in 1989 (appendix D3d), relenting the reduced activity.

1990-91: The number of mainland longliners declined sharply from the 1987-88 peak. Only about 15 mainland longliners were reportedly deployed in the fishery during 1990-91.[247] NMFS records show 17 longliners in 1990 and 14 in 1991 (appendix A2b). One observer in Puerto Rico believes that this sharp decrease was caused, at least in part, by stricter access arrangements implemented by several Caribbean islands.[248] Landings in San Juan increased from the low 1989 levels, reflecting more vessel activity in San Juan. Some vessels operating from the Virgin Islands appear to have shifted to San Juan. Landings in the Virgin Islands were minimal in 1990-91 and very limited in 1992-93 (appendix D3d). One factor explaining the shift of vessels from the Virgin Islands may have been U.S. Food and Drug Administration (FDA) import guidelines concerning mercury which complicated landing swordfish outside the U.S. Customs Area.[249]

1992: Activity out of San Juan increased in 1992 as the number of mainland longliners increased to 22 vessels (appendix A2b).

1993: The swordfish fleet declined during 1993 season. Only 17 longliners worked out of San Juan (appendix A2b).

1994: A few additional mainland fishermen decided to operate out of San Juan in 1994. NMFS reports that 21 longliners operated there in 1994 (appendix A2b). According to a local observer, six U.S. longliners owned by the same group

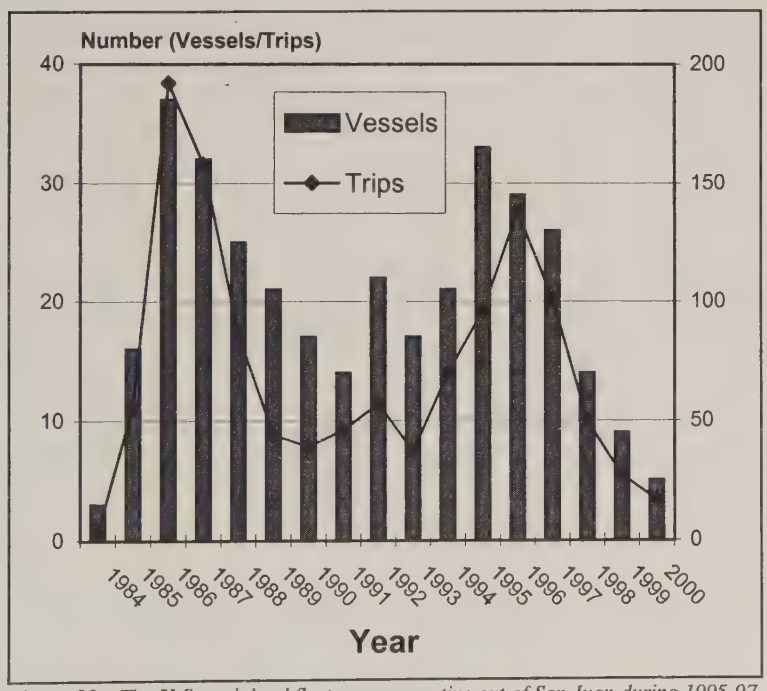

Figure 23.--The U.S. mainland fleet was very active out of San Juan during 1995-97, but effort has since dropped precipitously.

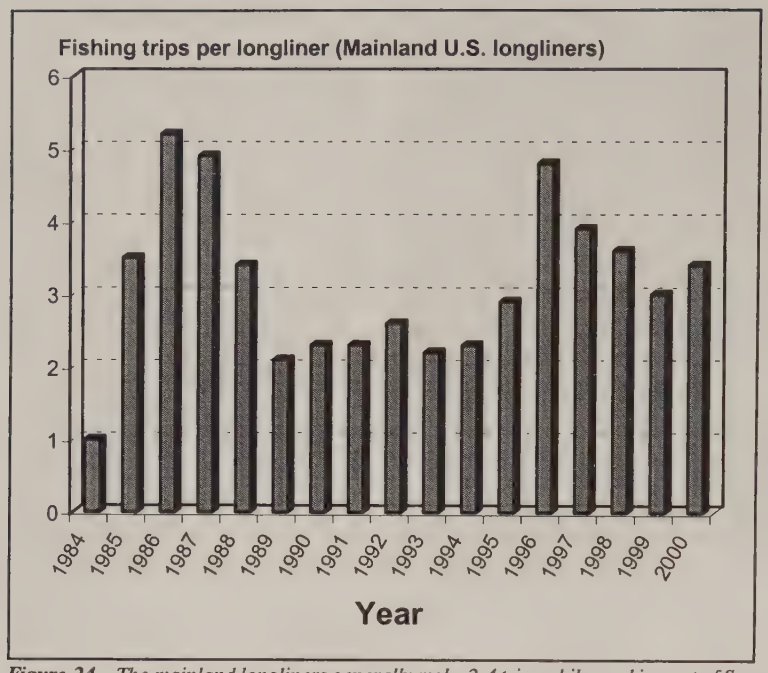

Figure 24.--The mainland longliners generally make 2-4 trips while working out of San Juan, but during the peaks in the fishery the average has been about 5 trips.

shifted operations in 1995 to Puerto Rico after fishing from Hawaii.[250]

1995: Mainland effort increased sharply in 1995. NMFS records indicate that 33 mainland longliners made nearly 100 trips in 1995 (appendix A2b). One Puerto Rican official estimated a much more significant effort with about 50 U.S. longliners landing swordfish and tuna in San Juan during 1995.[251] Some U.S. vessels that had been fishing out of Trinidad reportedly shifted operations to San Juan in 1995.[252] Activity out of San Juan was also affected by Hurricane Marilyn which devastated the Virgin Islands in 1995. The longliners that had transhipped there could no longer do so.[253] Several transferred operations to San Juan.

1996: NMFS records show that 29 mainland longliners called at San Juan in 1996. Although this was down from 1995, the number of trips increased to almost 140 (appendix A2b). The fishermen averaged nearly 5 trips per vessel. Several longliners were reportedly damaged or destroyed by Hurricane Marilyn in 1995. Several other fishermen reportedly sold their vessels.

1997: Quite a number of mainland fishermen continued operating in 1997. NMFS records show that 26 longliners made over 100 trips (appendix A2b). The 1996-97 period was the second peak of mainland activity in the Caribbean.

1998: Many mainland masters decided not to work seasonally out of San Juan in 1998. NMFS reported that 14 mainland longliners worked out of Puerto Rico during 1998 (appendix A2). The fishermen reported only 50 trips, about half of the number in 1997. The falling prices for swordfish on the U.S. market (appendix E3) must have been a factor on the part of any captains deciding to cease Caribbean operations. The fishermen that did work out of San Juan were particularly active around Trinidad. They reported especially good tuna catches (yellowfin and albacore).[254]

1999: Mainland operations fell further in 1999. Only 9 longliners worked out of San Juan and they made a total of only 27 trips, averaging 3 trips per vessel (appendix A2b).

2000: A local dealer reports that far fewer U.S. mainland longliners worked out of San Juan in 2000, making it difficult for him to fill orders.[255] NMFS records show that only five mainland longliners were active in 2000 (appendix A2b). A major factor in U.S. mainland operations is fuel costs.[256] The increase in fuel prices during 2000 was a factor in the sharply lower number of mainland longliners participating in the Caribbean fishery.

2001: Preliminary reports as of June 2001 indicate that mainland activity had fallen significantly. Only 4 mainland longliners were active out of San Juan early in the year (appendix A2b). Another observer reported in July that he had worked with 9 mainland longliners.[257] Local observers working with the longliners report that most of the small number of longliners entering San Juan harbor in 2001 have come primarily to obtain fuel and other supplies and not to land their catch.[258]

The operations of the mainland U.S. longliners based in both Puerto Rico and the USVI are highly seasonal. Some U.S. longline fishermen operating along the Atlantic coast shift to Caribbean and western Atlantic during the winter. The overall number of vessels deployed declined significantly after the 1987-88 season, but 10-15 U.S. longliners appear to have continued operating, primarily from December to April.[259] Most of the U.S. vessels return to the mainland during the summer for operations along the Atlantic coast, but sometimes return to San Juan, the U.S. Virgin Islands (USVI), or elsewhere in the Caribbean during the fall. The fishermen reportedly move to other Caribbean islands (such as Barbados, Trinidad, and St. Lucia) when they hear of good fishing to the south of Puerto Rico.[260]

U.S. fishermen in the late 1980s were landing substantial quantities of swordfish in various Caribbean ports (especially Trinidad, Haiti, various Windward Islands, and Barbados) (Caribbean Overview, appendix E1). U.S. fishermen, for example, landed over 180 t

in Trinidad during 1989. Since 1991 these landings have declined sharply and in recent years have involved only small quantities, mostly landed in Barbados and Trinidad. Scattered reports in 1995, for example, suggested some U.S. fishermen operated out of Trinidad.[261]

The U.S. mainland longliners are generally owner-operated vessels. There are two major groups of owner/operators working out of San Juan. One such group owns four vessels while the other (Gallamore group) owns six vessels.[262] The number of longliners operating off San Juan totaled over 30 in 1995, but has declined to only 5 vessels in 2000 (appendix A2b). Fishermen leaving the fishery in the early 1990s were being replaced with new entrants.[263] After 1997, however, a steady stream of mainland longliners have been withdrawn from the fishery.

Trip lengths vary somewhat, being affected by a variety of factors. The major factor limiting trip length is that almost all of the vessels target markets for high-value fresh product. This need to land a high-quality product places a major constraint on trip length. Other factors include: fishing results, weather, fuel usage, equipment breakdowns, and vessel maintenance. Reports on trip length vary. One observer indicates the fishermen generally take trips of about 15 days, averaging about 10 trips during the entire fishing season (usually December-April).[264] Another observer describes trips of up to 3 weeks.[265] Yet another observer indicates that the longline fishermen generally make 2-4 week trips, averaging 3-5 trips per season.[266] Some larger longliners operating at some distance from San Juan may make 30-day fishing trips. During this period, the fishermen make 18 sets.[267] The fishermen operate on grounds as far as 1,500 km from port. U.S. logbook data indicated, however, that the fishermen rarely go beyond 45°W (figures 15).[268] That would be about 650 km east of San Juan.

Most of the mainland longliners carry 4-5 fishermen, the captain and a crew of 3 or 4 persons. The crew of this size is required for the arduous operation of setting the lines, baiting hooks, and retrieving and dressing the catch.[269] Some of the larger vessels, however, carry 6-7 persons.[270]

The fishermen deploy a variety of lines to varying lengths. The lines and other associate gear are costly and expensive to maintain. One U.S. fisherman estimates gear costs at about $20,000 annually.[271]

Test: The longline deployed is typically about a 3.5 mm 700-900 lb (315-400 kg) test mono-filament nylon.[272]

Length: One observer in 1987 estimated that the lines range in length from 55-80 kilometers.[273] Current observers note lines which range from about 30-110 kilometers. A Puerto Rican official notes that some of the smaller vessels have lines as short as 30 kilometers.[274] One of the U.S. fishermen reports that most of the U.S. vessels deploy lines ranging from 80-110 kilometers.[275]

The mainline is stowed on a hydraulically operated spool. The vertical hook lines (gangions) are suspended from the mainline and use 180-kg test mono-filament line.

Depths: Some fishermen use vertical lines which are composed of three different sections. The leader, which is about 6 m and attached to the hook, is connected to another section which is 12 m in length. It is this section which is attached to the different length gangions. The gangions are directly attached to the mainline.[276] Fishermen use different length gangions, depending on the depth needed to reach the desired water temperature. Gangions of about 10-40 m are most common.[277] Another observer suggests depths of 90 m, explaining that the cooler water below the thermocline is a habitat for the prey species such as squid which swordfish and thresher shark target.[278] Some fishermen set as deep as 300-400 meters.[279]

Hooks: The fishermen commonly deploy at least 500 hooks for each set. Number 9 J-hooks are widely used by the

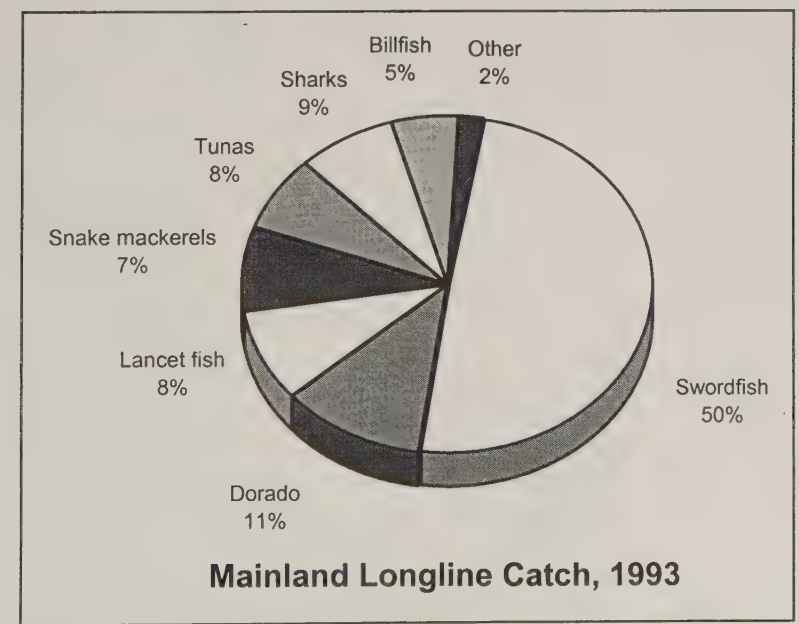

Figure 25.--The mainland fishermen report varying catch composition. In 1993, half of the catch in number of fish were swordfish.

Photo 24.--These radio reflectors are used to help the longline fishermen stay in contact with their line even at night or during rough weather. William Folsom

fishermen. Another observer reported the number of hooks per longline at 800-1,200. Some of the mainland fishermen operating off the larger longliners deploy as many as 1,500 hooks.[280] They are normally spaced at intervals of 60-90 meters.[281] One fishermen reports 92 m (100 yards) apart.[282]

Light sticks: Cyalume light sticks to attract the fish are attached to the gangions with rubber bands. The light sticks are normally set 3-4 m above the bait.[283] Some of these light sticks are equipped with a plastic hook to make it easily and quickly attached or removed during fishing operations.

Placement: Fishermen tend to place their lines at the edge of currents and thermal fronts.[284] Precisely how they place their lines along these features varies greatly among the fishermen.

Bait: American longline fishermen generally use squid, especially when setting for swordfish.

The U.S. longliners are normally equipped with extensive electronic instruments. Longliners normally carry a fishfinder, GPS, ADF for beeper buoys, surface temperature units, and satellite receivers to get sea-surface temperature information.

The fishermen normally set their longlines at dusk (around 7:00 pm) because of the nocturnal feeding habits of swordfish. The most commonly used bait items are squid and Atlantic mackerel which are often dyed. As the mainline is deployed, it is maintained at a specific depth by inflatable polyethylene buoys. Aluminum marker poles (5-6 m) are placed every 0.8-2.5 km along the mainline to which strobe lights and radar reflectors ("high flyers") are attached. The gangions (with leaders and hooks), floats, and marker poles are all attached to the mainline with stainless steel snap-on connectors. Different types and hook styles are used, but most are big game fish hooks, varying in size from 8/0-12/0. Three crew members are usually employed to bait the hooks, connect the gangions and buoy lines to the main line, prepare the marker poles, and to operate the winch while the master pilots the vessel.[285]

Once the longline is set, the vessel drifts nearby tracking it visually or with radar. The fishermen commence the "haul back" procedure before dawn the following morning (usually about 5:00 am). The first buoy is retrieved and the mainline is attached to the hydraulic spool by a "fair leader." As the boat moves slowly along the line the floats and gangions are retrieved and removed as they are pulled aboard. When hooked swordfish are encountered, they are brought alongside and the boat stopped. The fish are then "hand-lined" and then gaffed to bring them aboard. Billfish and some sharks are often tagged and then released.[286] Hauling in the longline may take as much as 6 hours, depending on the length of the lines, but is usually completed by about 10:00 am.[287] After the line is hauled in, necessary repairs are made to the gear and it is prepared for the next set.[288]

The fish are immediately dressed when brought aboard the vessel and then stored on ice while the fishermen continue hauling in the line. The dressing procedure consists of severing the head, cutting off the tail and fins, and gutting the fish. The fish are stored on ice made from seawater, but some fishermen use a salt-brine storage method.[289]

The catch composition reported by the fishermen varies annually and by season. Fishermen reported in 1993, for example, that in the Caribbean about half their catch was swordfish (appendix G1b). Recent landings data, meaning the discarded by catch is not included, show an even higher composition of swordfish in the Caribbean, 85 percent during 1998-99 (appendix G1b2b). The swordfish composition of other

Photo 25.--The "Janice Ann" is one of the many mainland U.S. longliners that have operated seasonally out of Puerto Rico. William Folsom

areas generally fished from San Juan was also high in 1998-99 (70-86 percent) (Caribbean Overview, appendices G1c8-G1c9). Fishermen off Florida's eastern coast report high, but lower levels of swordfish in the landings (66-72 percent) (Caribbean Overview, appendix G1c3a). Longline fishermen in the Gulf of Mexico, however, report that swordfish is s less important part of the landings (13-17 percent) (Caribbean Overview, appendix G1c2).

Estimates on the yields achieved by the fishermen vary somewhat. Puerto Rican officials estimated that during 1995 the longliners catch about 4.5-6.5 t (dressed weight) of swordfish per vessel per trip (10 trips/season).[290] A local observer in 1995 estimated the average swordfish catch per vessel per trip at about 8.5 t (3-5 trips/season).[291] Another local source in 1999 reports that the total catch per trip averages about 8 t of swordfish and 4 t of tuna, or 12 t per trip.[292] According to a U.S. mainland fisherman, the swordfish catch generally ranges from 5-13 tons per vessel on 30-day fishing trips (generally 18 sets).[293]

The fishermen have purchase arrangements with San Juan brokers. When they have completed fishing operations, they radio the brokers on the way back to port. Upon arrival in San Juan (Isla Grande) the dressed swordfish trunks are unloaded, the brokers pack them in boxes with dry ice which are then placed inside specialized airline shipping containers (cans) which can be inserted directly into normal commercial airliners to facilitate rapid airshipment. Each of these containers have a capacity of 1.5 tons.[294] The whole unloading and packing process is usually accomplished in less than 2 hours. The brokers have trucks standing by to immediately transport the containers to the nearby San Juan airport which usually takes less than half an hour. Much of the fish is reportedly shipped to Boston dealers.

One factor affecting fleet operations is the price the fishermen receive for their catch. The higher the price, the more intensely the fishermen are motivated to target any given species and the further from their home port they are willing to travel. Swordfish prices peaked in 1987 (appendix E3) and it was then that the peak U.S. activities reported in the Caribbean (appendix A2a). The fishermen in the mid 1990s were receiving good prices and there was considerable interest in caribbean operations.[295] Fishermen in 1996 were not only increasing the number of boats working out of San Juan, but were also increasing the number of trips per boat (appendix A2b). Prices fell to very low levels in 1997-98 (appendix E3) and notable reductions in Caribbean deployment can be observed beginning in 1998 (appendix A2b). Prices have since declined substantially.

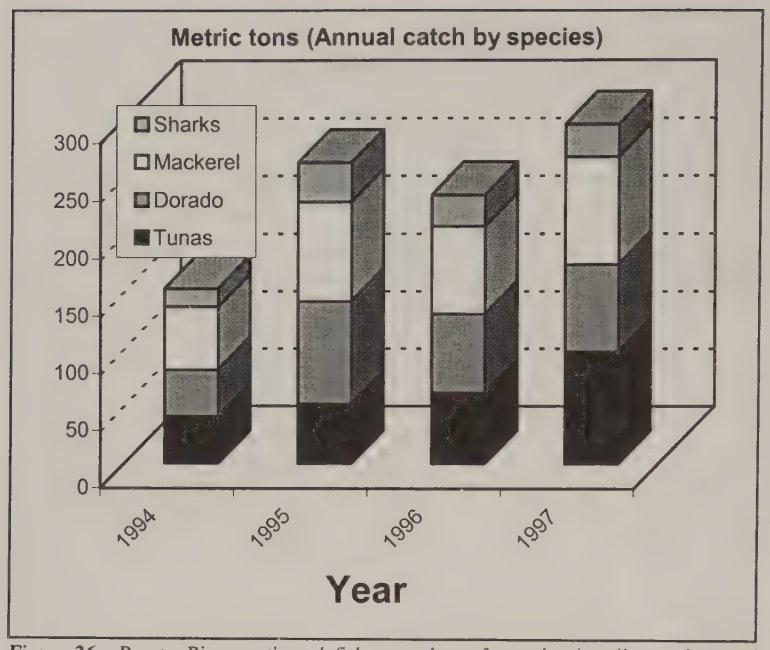

Figure 26.--Puerto Rican artisanal fishermen have focused primarily on demersal species. Pelagic catches have been very limited, but are increasing.

Pelagic catches are still relatively limited, but the fishermen have gradually shifted some effort to these pelagic species. Catches during the 1990s have increased, although fluctuating from year to year (appendices D2c-d). The principal pelagics taken are tunas, mackerels, dorado, and shark. The tuna fishery in particular has proven highly variable from year to year, but the overall pattern appears to be an increasing catch (appendices D2c-d).[298] A NMFS Enforcement Agent in 2001 reports that since the closing of the StarKist cannery in May 2001 that an increase in yellowfin catches has been noted off both the east and west coast. A substantial number of Puerto Rican fishermen have expressed an interest in the tuna fishery (appendix A5). Small amounts of barracuda and occasional wahoo are taken. Billfish are reserved to the sports fishermen.

VII. Catch

A. Domestic catch

Commonwealth efforts to promote fisheries succeeded in expanding fisheries production on Puerto Rico during the 1950s and 1960s. The fishermen in their small yolas were only able to target nearby inshore waters which, as a result, were heavily fished. Catches peaked in the late-1970s. Catches in recent years have ranged from 2,600 t (1997) to only 1,500 t (1991). The 1998-99 catch of 2,100 t appears to be about midway between those extremes (figure 2 and appendix D1a).

The Puerto Rican fishery has traditionally focused on demersal species in costal waters. As late as the 1980s, pelagic species were a very small part of the catch (figure 4 and appendix D1c). A variety of studies have shown that inshore waters are severely overfished.[296] Government officials, as a result, have encouraged fishermen to target demersal resources on the shelf slope and offshore oceanic pelagics. Some observers question the sustainability of newly developed fisheries on the shelf slope.[297]

Domestic artisanal fishermen reported no significant swordfish catches. Only small, sporadic catches are taken and swordfish does not normally appear in the data reports (appendix D2d). One Puerto Rican fishery biologist reports that swordfish catches by artisanal fishermen are normally null to zero.[299] Fishermen in 1988, for example, caught 3 t of swordfish. In most years, however, no swordfish is reported at all.

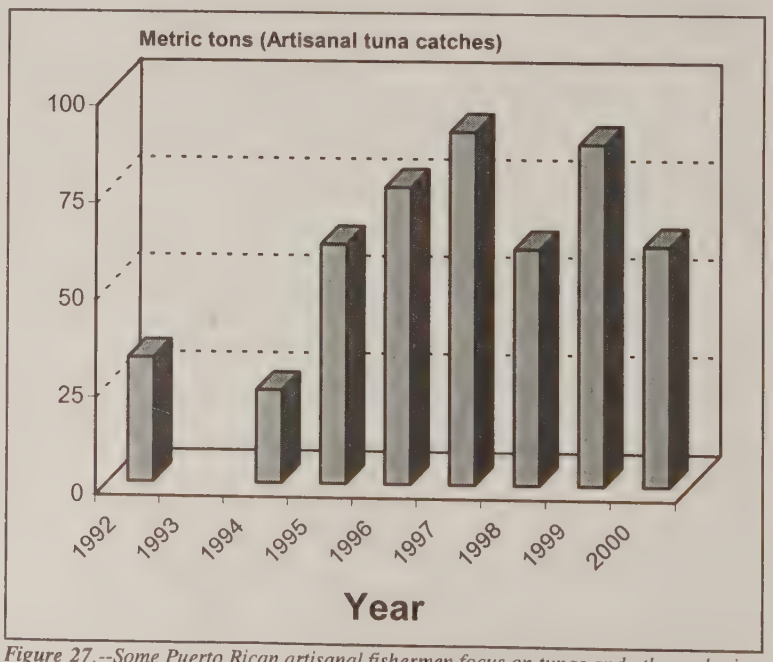

Figure 27.--Some Puerto Rican artisanal fishermen focus on tunas and other pelagics. The tuna catch, however, has fluctuated greatly in recent years.

B. Mainland longliners

The U.S. longline fishermen operating in the eastern Caribbean/western Atlantic have in most years landed most of their catch in San Juan, Puerto Rico. Landings (since reliable data has become available) in 1986 have varied from a high of 780 t in 1986 to a low 135 t in 1989. Fishermen in 1995 reported particularly good landings approaching 640 t (appendix D3a). Additional significant quantities were landed in the USVI during some years (especially 1987-89 and 1994-95).[300] There have also been significant landings in other Caribbean ports (Caribbean Overview, appendix E1).

1984-85: Many of the mainland U.S. fishermen did not report their catch during 1984-85, but the U.S. regional Caribbean Fisheries Management Council (CFMC) estimated that catches could have exceeded 450 tons.[301] The average dressed weight of the fish taken exceeded 45 kilograms.[302] The 1984 catch actually reported by the fishermen was minimal, but they reported sizeable landings (250 t--product weight) in 1985 (appendix D3b).[303] Actual landings may have been significantly higher as reporting was not mandatory.

1986: More mainland fishermen were attracted by the excellent yields reported in 1985. U.S. fishermen landed a record 780 t of swordfish in San Juan during 1986 (appendix D3b). Actual landings may have been somewhat higher as reporting did not become mandatory until mid-way through the year.

1987: Fishermen reported a disappointing catch in 1987. San Juan swordfish landings in 1987 declined to only 580 t, possibly because several fishermen began landing fish in the nearby USVI (appendix D3b). Caribbean landings in Florida ports also increased.

1988: Fishermen reported that catches continued to decline in 1988, falling to levels less than half those of the record 1986 catch. U.S. fishermen landed less than 300 t of swordfish in San Juan during 1988 (appendix D3b). The fishermen, however, sharply, increased landings in the USVI.

1989: U.S. fishermen reported even lower landings in 1989. The fishermen landed only 135 t at San Juan in 1989 (appendix D3b). They also reduced their USVI landings.

1990: U.S. fishermen reportedly landed 230 t of swordfish in San Juan during 1990 (appendix D3b). The increase may have been, at least in part, due to the fishermen's decision to virtually cease using the USVI to land their catch.

1991-92: U.S. mainland fishermen again landed about 230 t of swordfish in San Juan during 1991-92 (appendix D3b). The fishermen continued to avoid landings in the USVI, but increased Florida landings of Caribbean-caught fish to over 235 t in 1991.

1993: U.S. swordfish landings in Puerto Rico fell to only about 215 t (appendix D3b). Landings in the USVI increase slightly, but nearly 300 t of Caribbean-caught fish was landed in Florida ports.

1994: U.S. fishermen reported increased landings during 1994, landing over 310 t (appendix D3b). Caribbean landings in the USVI recovered to 130 t, but declined in Florida ports.

1995: U.S. fishermen operating in the wider-Caribbean reported one of their best seasons in 1995, landing more than 635 t at San Juan (appendix D3b). Landings in San Juan were affected by Hurricane Marilyn which devastated the U.S. Virgin Islands. Fishermen who had operated from the USVI were forced to use San Juan.[304] Puerto Rican sources believe, however, that the fishermen are landing substantially greater quantities of swordfish than they are reporting. One Puerto Rican official estimated landings exceeding 2,300 t in 1995.[305] Such an estimate seems very high to the authors. This may reflect in part the common local reaction when non-local fishermen with larger boats enter a fishery.

1996: Fishermen in early 1996 reported disappointing catches. One fisherman reports that they sometimes fill as many as eight 1.5 t-cans (airplane container inserts) on a good trip. Many of the fishermen in early 1996, however, were only filling

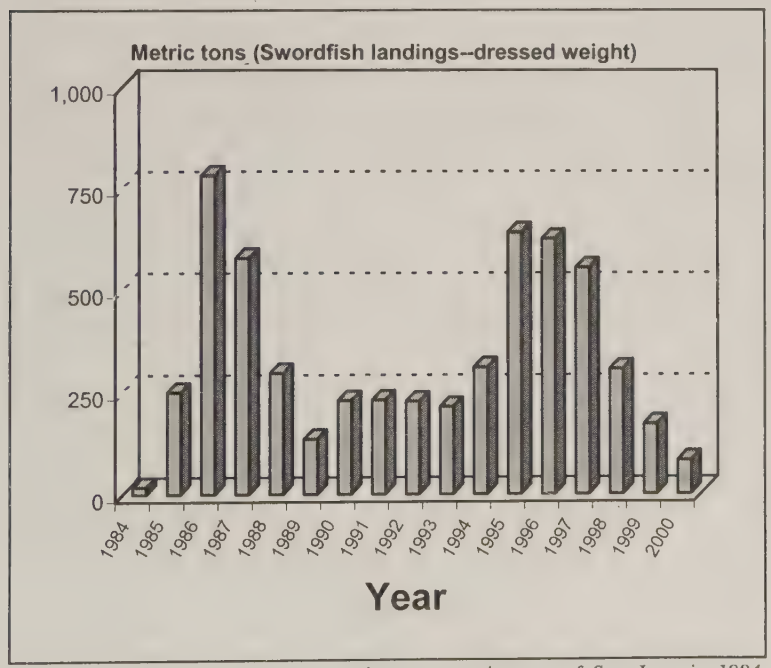

Figure 28.--U.S. mainland fishermen began operating out of San Juan in 1984. Landings have since fluctuated, but there has been a notable decline in recent years.

Photo 26.--Mainland landings in Puerto Rico are fresh eviscerated trunks. Landings have declined sharply in San Juan since 1997.

about 3 "cans".[306] Fishing apparently improved as year end results were 625 t, quite close to the 1995 catches (appendix D3b).

1997: Fishermen continued landing substantial quantities of swordfish in San Juan during 1997, but below the high 1995-96 levels. Swordfish landings totaled 555 t in 1997 (appendix D3b). Prices received by the fishermen dropped. The decline was especially notable in Massachusetts ports (appendix E3). This was significant as a sizeable part of the Puerto Rican transhipments are marketed through Boston.

1998: Mainland fishermen continued reducing effort in 1998. Landings totaled only slightly over 305 t in 1998 (appendix D3b). Operations appear to have been affected by the significantly increased quantities of swordfish imported beginning in 1997 (appendix F2b) which reduced prices. Sharply lower prices were reported by U.S. fishermen beginning in 1997 and they declined even further in 1998 (appendix E3).

1999: Many mainland fishermen did not return to the Caribbean in 1999. Landings fell to only about 170 t (appendix D3b). Fishermen complained of low prices in 1999 and competition with Spanish imports.[307] The sharp reductions in prices during 1997 and 98 (appendix E3) were adversely affecting earnings. The authors are unsure, however, why the fishermen believed that the Spanish imports were such a problem. Imports did not increase in 1999. Imports in 1999 actually declined, but were higher than pre-1997 levels. Nor was Spain an important supplier to the United States (appendices F2b-c). It may be that U.S. fishermen have encountered Spanish fishermen at sea during fishing operations and perceive their operations as threatening their market. Spain does conduct a large Atlantic longline fishery.

2000: Mainland landings in San Juan continued to decline in 2000. Only about 80 t of swordfish were landed (appendix D3b). Increasing fuel prices were reportedly one factor in limited operations from San Juan during 2000. U.S. mainland fishermen were less likely to pursue Caribbean operations because fuel is such a large part of the costs associated with fishing, especially when operating at considerable distance from home ports.[308] Swordfish prices increased slightly in 2000, but are still well below levels received before 1997 (appendix E3).

2001: Only four U.S. longliners fished out of San Juan through June. The vessels that did operate reported poor catches.[309] The fishermen report operating further north and east than in the past. Fewer fishermen are reportedly landing their catch in San Juan, but instead taking the catch back to mainland ports from which they operate. A factor is the freight costs for shipping from San Juan.

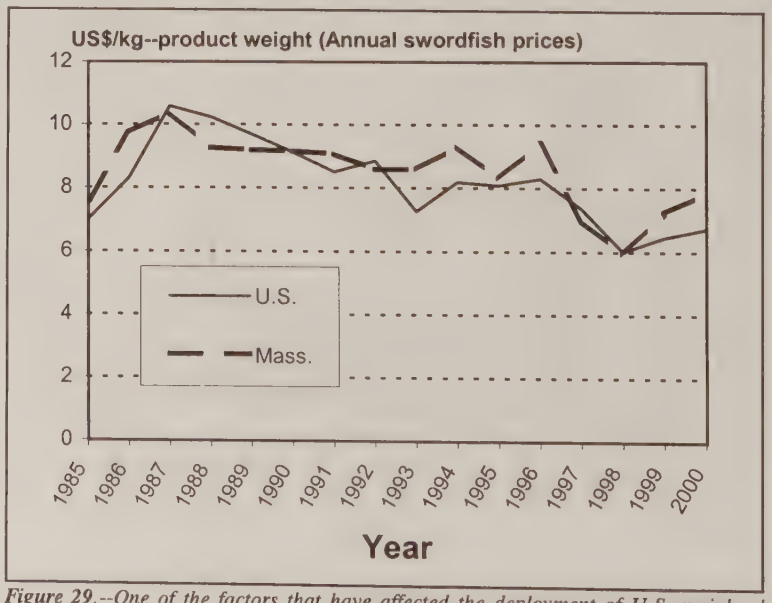

Figure 29.--One of the factors that have affected the deployment of U.S. mainland longliners in the Caribbean has been swordfish prices.

Photo 27.--Mooring and landing sites for artisanal fishermen are found all along the Puerto Rican coast. Often the sites are also used for pleasure and recreational boats. Julio Serano

VIII. Ports

A. Artisanal sites

Puerto Rican fishermen land their catch at a large number of sites scattered all along the coast. One report lists 63 different fishing centers or artisanal villages ("centro pesqueros") in 41 municipalities--including Vieques and Cúlebra Islands. Many of these sites are quite small sites with limited facilities and only minor quantities are landed there. Often facilities are shared with recreational boats, including sports fishermen. Cabo Rojo in the west is the most important port.

Most of the larger fishing centers are located along the western coast where more than half of the island's fisheries catch is landed.[310]

West: The principal western ports are: Cabo Rojo and Aguadilla.[311] Cabo Rojo is by far the most important fishing port on Puerto Rico. About one-fifth of the island's total catch is normally landed at Cabo Rojo (appendix D1d). The west coast ports are particularly important to the pelagic fishery. Fishermen in the west-coast villages land about 70 t of pelagic fish annually.[312] Much of the island's catch of large pelagics is taken from the west coast ports. The artisanal fishermen targeting tuna generally operate from west coast ports, especially Aguadilla, Aguada, and Rincón. While much smaller than Cabo Rojo, these three ports play an important role in the island's pelagic fishery.

South: Most of the remaining catch is landed along the southern coast. Several ports there are of some importance, including Guyana, Salinas, Guánica, and Lajas.

East: Only small amounts are landed along the eastern coast, primarily at Fajardo, Naguabo, and Ceiba. There are also important centers on the islands of Cúlebra and Vieques off the eastern coast.

North: There are no large ports along Puerto Rico's northern coast.[313] There are, however, many small landing sites (appendix C1). In addition, the western ports where the fishermen targeting tuna operate (Aguadilla, Aguada, and Rincón), are located at the northeastern corner of the island.

Operations at the various fishing villages vary greatly. Many have PR-DA landing and marketing facilities. Others have privately owned facilities. In some cases, groups of fishermen have organized to manage the facilities. Well managed ports in recent

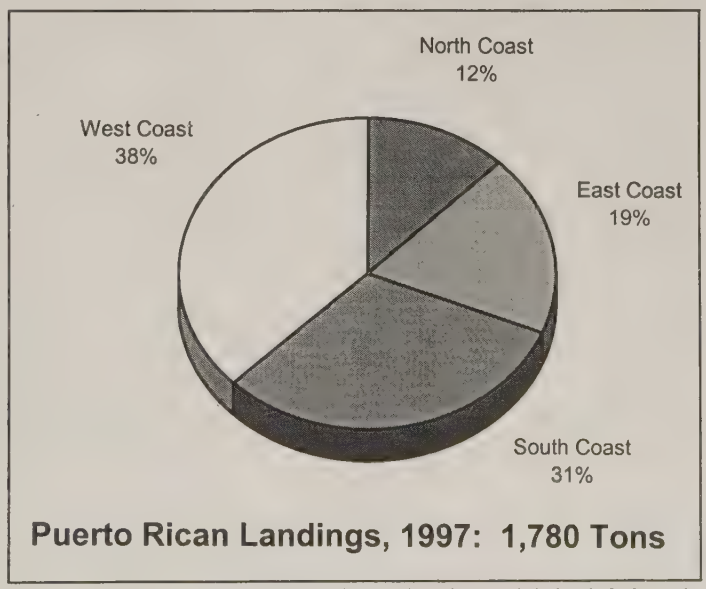

Figure 30.--Most of Puerto Rico's artisanal fisheries catch is landed along the western and southern coasts. The western ports are particularly important to the pelagic fishery.

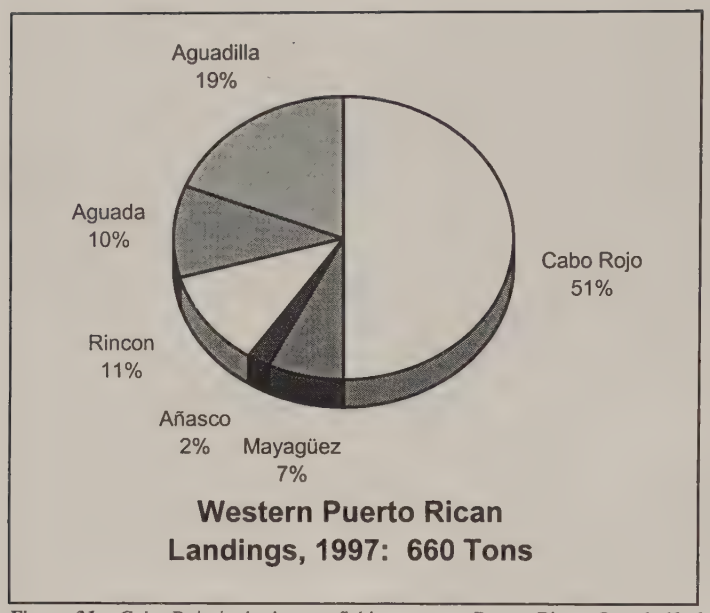

Figure 31.--Cabo Rojo is the largest fishing port on Puerto Rico. Over half of the western catch is normally landed there. Other western ports are important to the small fishery for oceanic pelagics.

based in these three ports. The permitted dealers handling tuna are also primarily located in these three ports (appendix E2a-b).

San Juan, located along the northern coast, is Puerto Rico's capital and principal urban center. About one-third of Puerto Rico's 3.5 million people live in the San Juan area and thus constitute the island's principal seafood market. Puerto Rican artisanal fishermen, however, only land very small quantities of fish at San Juan. The artisanal fishermen land most of their catch at landing sites in the west and south of the island, some distance from San Juan. Some fish is trucked into San Juan, but much of the catch is consumed locally rather than used to supply the San Juan market. Much of the fish consumed in San Juan is imported product.

years have attracted increasing numbers of fishermen from neighboring villages by offering better prices. Revenue from fish sales are used to improve facilities, and in some cases finance loans to upgrade vessels. Facilities at these ports vary greatly. One of the larger artisanal ports (Aguadilla), for example, supports over 100 open fiberglass and wooden boats, mostly 5-7 meters in length. The reported catch varies considerably from year to year. Fishermen during 1994-97, for example, reported catches ranging from 50 t to 140 t (appendix D1d). One observer, however, believes that many fishermen apparently do not report their catch. The fishermen use both lines and traps. None deploy longlines. They target shark, tuna (albacore and yellowfin), dorado, bonito, chillos, and other species. Billfish, while prohibited, are occasionally taken. The port has two walk-in cold stores that hold 8 t of fish each and equipment to process fresh and frozen fish. Some of the tuna is purchased by the StarKist cannery in Mayagüez. Facilities at many other ports, however, are more basic.[314]

The northwestern coast is where artisanal fishermen most commonly deploy lines for oceanic pelagics. There is artisanal longline activity off the other coasts as well, particularly out of east coast (especially Vieques) and the west coast (especially Aguadilla and Mayagüez) (appendix C1). Fishermen using small boats to handline for tuna operate out of a number of ports (especially Aguada, Aguadilla, and Rincón) (appendix A5). There were 110 such boats permitted for tuna in 2001 and the vessels were mostly

Photo 28.--The mainland longliners all land their catch in San Juan, in part because it is where the international air port, through which the fresh fish is shipped, is located. Julio Serano

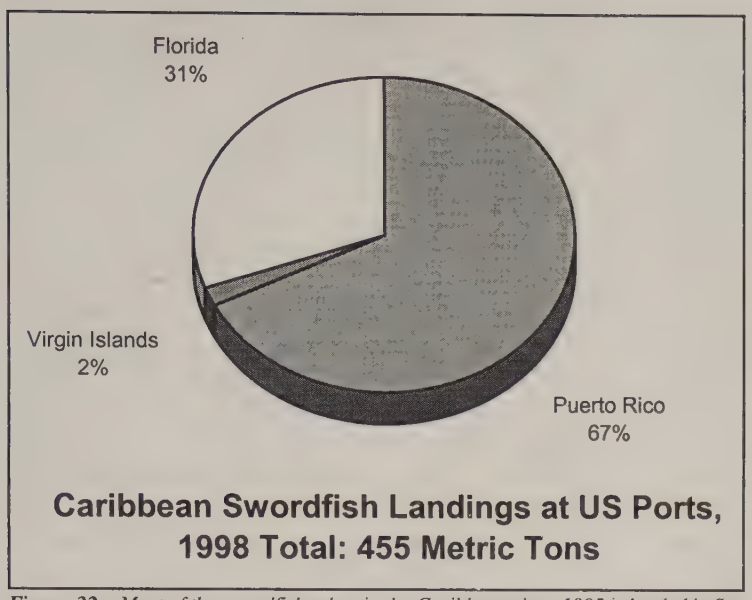

Figure 32.--Most of the swordfish taken in the Caribbean since 1995 is landed in San Juan. Some of the catch is landed in Florida, but since 1995, only small quantities in the U.S. Virgin Islands.

B. Commercial ports

Several Puerto Rican ports report commercial fisheries traffic. Tuna is landed or shipped to Mayagüez and Ponce. The U.S. swordfish longliners use San Juan.

Mayagüez: Mayagüez is the principal city along the western coast. Tuna is delivered to Mayagüez canneries by refrigerated cargo vessels and an U.S. seiners. Most of the canneries have closed, but in 2001, one was still operating. The canneries have imported substantial quantities of frozen tuna (albacore, skipjack, and yellowfin) for canning. The canneries imported tuna throughout the 1990s, although imports dropped sharply in 1999 and 2000 (appendix F3a). This presumably reflects declining activity at the canneries.

Ponce: Ponce is the principal south-coast city. Tuna was delivered to a cannery in Ponce by refrigerated cargo vessels and U.S. seiners. One Ponce cannery, however, was moved to southeast Asia during the early 1990s.[315] No canneries in 1996 were operating at Ponce.

San Juan: San Juan is located at the northeastern corner of the island. Most U.S. longliners operating in the eastern Caribbean/western Atlantic call at San Juan to land their catch. The Isla Grande facilities in the San Juan harbor are adequate for the fishermen and also service the small inter-island freighters supplying food and manufactured goods to the various eastern Caribbean islands. The fishermen are usually able to obtain services immediately upon entering the port, crucial when handling fresh product. Port services are reportedly more readily available and reportedly cost less than other alternative ports such as the USVI.[316] San Juan is a convenient point for the fishermen as it is nearer to the fishing grounds than most other Caribbean ports. Isla Grande is close (about 8 km) to the San Juan International airport which is one of the busiest in the Caribbean. The extensive flight schedule facilitates rapid air shipment, critical to maintaining the quality of the fresh product being landed. The fishermen land their catch, obtain provisions, supplies, and bait. San Juan offers many other advantages, including excellent port facilities and a developed financial and communications infrastructure.[317] Puerto Rico also has the advantage of being a U.S. port. Thus there are no complications with foreign fishing, port, and tariff regulations. In addition, unlike the nearby USVI, Puerto Rico is within the U.S. Customs Area. More than 70 mainland longliners may have used San Juan during the peak of the fishery (1987-88) (appendix A2a). As recently as 1995 there were 33 mainland longliners working out of San Juan. This has since sharply

Photo 29.--Swordfish landed in San Juan by the U.S. longliners is mostly air freighted to the U.S. mainland in these containers. Julio Serano

declined. Only 5 mainland longliners are known to have worked out of San Juan in 2000 (appendix A2b). (See: "VI. Fleet.") A NMFS agent has noted five longliners at Pier 5 in 2001, through September. NMFS agents plan to more regularly interview the captains of these vessels when they dock at San Juan. The quantity of swordfish moved through San Juan has varied greatly each year, but has been as high as 780 t (product weight) (appendix D3b). (See: "VII. Catch.") NMFS reports that over 300 t was shipped through San Juan in 1998, but some local observers provide higher estimates. Shipments have declined in 2000 to only about 80 tons. A wide range of factors determine whether mainland longliners use San Juan, including catch rates, fuel prices, and swordfish prices. The new NMFS HMS management plan is probably another factor. U.S. mainland fishermen are limited by the U.S. allocation under the ICCAT management plan. If they can take that amount on mainland grounds close to their home ports, they are less likely to take the time and incur the expenses associated with moving to distant Caribbean grounds during the offseason.

C. Recreational marinas

There are several major marinas harboring recreational vessels as well as a number of smaller ones. The most important marinas are: San Juan (Club Nautico y San Juan Bay), Fajardo (Marina Puerto del Rey y Villa Marina), Ponce (Club Nautico), Arecibo (Club Nautico), and Mayagüez (Club Nautico).[318] Extensive storage facilities exist at several marinas for boaters and anglers who only use their boats on a seasonal basis.

***Photo 30.**--Small recreational boats are stored on racks at the San Juan Bay Marina. NOAA Photo Library*

IX. Transshipments

Foreign fishermen do not transship their catch through Puerto Rico. As a U.S. Commonwealth, U.S. laws apply in Puerto Rico which prohibit almost all foreign fishing vessels from landing their catch in U.S. ports.[319] FDA import regulations provide further complications for foreign fishermen desiring to land swordfish in U.S. ports.[320] Some small longliners from various Caribbean islands (Antigua, Barbados, Trinidad, and St. Vincent) have inquired or attempted to land swordfish in Puerto Rico or the USVI, but the authors know of no such actual landings.[321]

U.S. mainland longline fishermen operating in the wider-Caribbean, primarily operate out of San Juan and land their catch there. Most of the high-grade swordfish and tuna is then shipped on to the United States. Some observers indicate that the bycatch and small quantities of swordfish and tuna, usually lesser-grade product, is sold to local buyers. At least one Puerto Rican distributor insists that he does not handle any lower grade product.[322] Many fishermen have ongoing relationships with buyers. Some of the buyers are the major established distributors. (See: "XI. Organizations. A. Companies.") Other buyers are individuals who operate informally. No data exists on these local sales and they are not entered into the Puerto Rican fisheries catch. Until 1995 there were also considerable activity out of the Virgin Islands, however, as a result of Hurricane Marilyn in that year operations there have been largely terminated.[323] Some Caribbean fishing also takes place from Florida ports.

U.S. longliners have also transhipped swordfish through various Caribbean countries. While quite a number of ports have been used, with a few exceptions rather minor quantities of swordfish has been involved. The countries involved have included: Aruba, Bahamas, Barbados, Haiti, Jamaica, Mexico, Trinidad, Venezuela, and the Windward Islands (Caribbean Overview, appendix E1). These transhipments have been generally minor and involved only a few years. The peak activity was reported during the late 1980s. The greatest activity has been reported at Port-of-Spain in Trinidad which is the major Caribbean transshipment center.

Barbados: Bridgetown, Barbados is the most easterly located Caribbean port. Actually Barbados is located in the Atlantic outside the Caribbean basin. As a result, it is a potential transhipment point for U.S. longliners operating in the Atlantic southeast of the Caribbean. The fishermen can transship in Bridgetown and refuel and buy supplies so that they can quickly return to the fishing grounds. The quantities involved have not been large, but in most years there have been some U.S. activity at Bridgetown. One peak of activity was 1988-89 when over

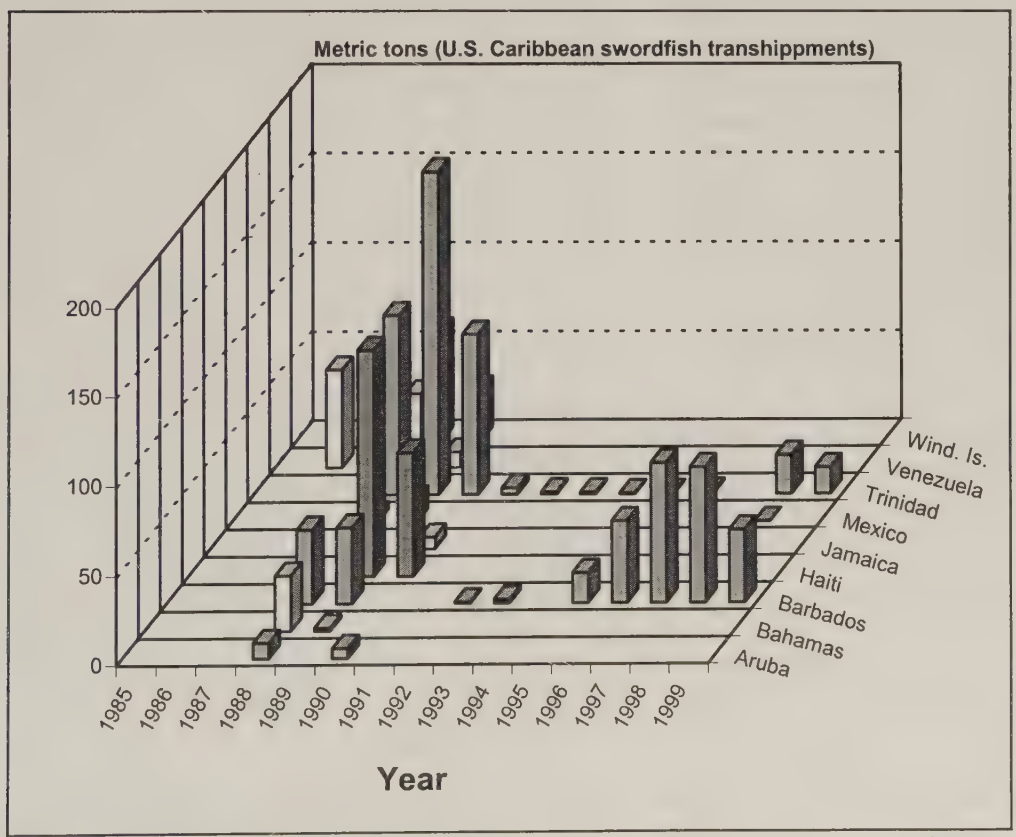

Figure 33.--U.S. fishermen have transhipped swordfish through various Caribbean islands. The two most important have been Barbados and Trinidad.

Photo 31.--Sea Lots at Port-of-Spain, Trinidad is the major Caribbean transhipment point. U.S. fishermen have transhipped there, but most of the transhipments are from Taiwan-owned longliners. D. Weidner

40 t of swordfish was transhipped each year, after which transhipments declined to minimal quantities. Fishermen in the late 1990s began using Bridgetown again, transhipping 40-80 t annually during 1996-99. (Caribbean Overview, appendix E1).[324]

St. Maarten: U.S. longliners have not extensively used the smaller transhipping facilities at St. Maarten.[325] Presumably because St. Maarten is so close to Puerto Rico that the longliners come in to San Juan or up until 1995 to the U.S. Virgin Islands. Operations at St. Maarten are primarily geared to handling frozen tuna and billfish. U.S. longliners focus on the more valuable market for fresh fish.[326]

Trinidad: The most extensive U.S. swordfish transshipments through Port-of-Spain were in 1989 and involved over 180 t of swordfish. Since then, only very small quantities have been involved. Shipments in 1998-99 increased slightly to about 15-20 t (Caribbean Overview, appendix E1). The transshipping is conducted at the Sea Lots facility of the old National Fishing Company which has been leased by two Taiwan companies. These facilities are the most important transshipping point in the Caribbean. The U.S. transhipments have been relatively minor. The Sea Lots Port-of-Spain facility transship much larger quantities of tuna, swordfish, billfish, and related species. The fish is being landed there by foreign longliners--primarily Taiwan-owned vessels.[327] Many of the vessels transshipping through Sea Lots are Taiwan owned, but flagged in other countries. While the quantities of swordfish transhipped Trinidad are relatively minor, very large quantities of tuna are transhipped by Taiwan-owned longliners. In addition, some of these longliners transship sizeable quantities of tuna, swordfish, and billfish at sea rather than tranship through Port-of-Spain and other transhipment points. These at-sea transshipments are is mostly destined for Japanese markets.[328]

Venezuela: U.S. longliners made some transhipments through Venezuelan ports in the late 1980s. Shipments in 1988 totaled over 60 t (Caribbean Overview, appendix E1). Other countries also transhipped through Venezuelan ports, but such activity peaked in the late 1980s.[329]

Puerto Rican fishermen operating a few larger vessels may be transhipping some of their catch through foreign ports. Puerto Rican officials have very little information on the operations of these larger vessels because they do not normally operate in Commonwealth waters. Officials believe that these multi-purpose vessels, some with longlines, operate on the highseas or off neighboring islands, especially the Dominican Republic. The officials speculate that these fishermen may be selling their catch in the Dominican Republic or other foreign countries. Dominican officials contacted by the authors, however, have no knowledge of any such sales.[330] Officials report that product from these vessels rarely appear in Puerto Rican markets. The authors believe, however, that swordfish is rarely taken by these fishermen. They may be taking small quantities of billfish and tuna.[331]

X. Processing and Products

A. Tuna canneries

Puerto Rico developed a major tuna canning industry. The first cannery was built at Ponce during 1953. Two large U.S. tuna canneries (Bumble Bee/Castle & Cook and StarKist/Heinz) and a Japanese company (Mitsui) subsequently built large, modern canneries in Mayagüez. One Japanese company (Mitsuishi Foods) opened the Caribe Tuna cannery in 1971 and Van Camp/Ralston Purina opened a cannery (two plants) in Ponce. Five tuna canneries operated in Puerto Rico during the 1980s. These canneries were an important employer in western Puerto Rico. The StarKist plant was once Puerto Rico's largest employer with 4,000 workers. The canneries processed tuna taken in the Eastern Tropical Pacific (ETP) tuna purseseine fishery by U.S. and foreign seiners. Low wage rates in Puerto Rico meant it was cheaper to can the tuna on the island than in mainland U.S. canneries located in San Diego.

The Puerto Rican canneries during the late 1980s and 1990s encountered financial difficulties. Some were adversely affected by efforts to protect ETP dolphins. One of the major problems, however, has been difficulty competing with low-cost Asian canneries (especially Indonesian and Thai canneries). Another major problem has been changes in U.S. Federal tax laws, which beginning in 1996 cost the Puerto Rican canneries much of their competitive edge.[332] Some of the large tuna companies involved have transferred operations to Asian countries. Other companies like Heinz which purchased StarKist were disappointed with the profit margins because the canning industry struggled with low prices and company officials concluded there were only limited prospects for future growth. The remaining Puerto Rican canneries in recent years have reduced production levels, been sold, or closed.[333]

The only two canneries operating in 1996 were Bumble Bee and Starkist, both located in Mayagüez. Starkist reportedly closed in March 2001.[334] Only the Bumble Bee cannery in Puerto Rico is now operating. These canneries processed substantial quantities of tuna, nearly 150,000 t of imported product in 1998 (appendix F3a). Much smaller quantities. however, were processed in 1999 and 2000.

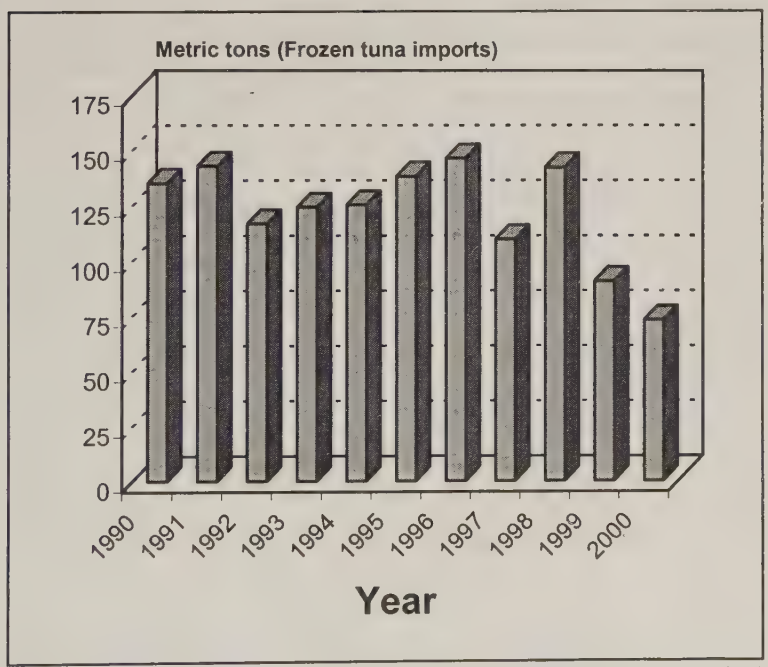

Figure 34.--Puerto Rican tuna canneries have closed or significantly cut back operations. Imports of frozen tuna for processing has declined sharply since 1998. Only one cannery is currently operating.

B. Domestic processing

Puerto Rico has no organized seafood processing industry, with the exception of tuna canning. There are very few companies producing value-added product such as fillets. Artisanal fishermen have generally inadequate handling standards. Only about half the fishermen gut the catch at sea. One 1998 report suggests that virtually no artisanal fishermen use ice to preserve the catch. Most of the fishermen were convinced that there was such a short time between catching and landing that ice was not required.[335] Most of the local artisanal catch is sold as whole fresh fish, although there is some gutting or further processing done by the fishermen themselves or in the few major wholesale/retail fish shops, mainly located in the San Juan area.[336] (See: "XII. Markets.")

C. Swordfish

Some observers believe that there is some potential in Puerto Rico to develop a modest processing industry for the oceanic pelagic catch of the longline fishermen.[337] This may take some time as few Puerto Rican companies (except the tuna canneries) conduct any form of commercial fish processing. Currently the swordfish is dressed (headed and gutted) aboard the

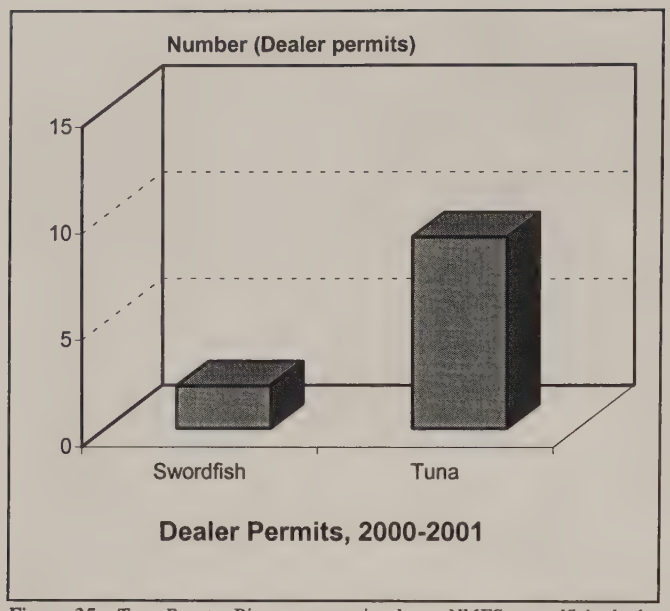

Figure 35.--Two Puerto Rican companies have NMFS swordfish dealer permits and nine companies have tuna dealer permits.

vessels. The San Juan brokers buying the fish, simply pack the swordfish trunks in boxes with dry ice and ship them inside specialized airship containers (cans). The cans containing the chilled trunks are immediately transported to the San Juan airport for shipment to the mainland, mostly to Boston and New York.[338]

A small amount of the swordfish landed in San Juan by the U.S. longliners is marketed domestically. The quantity involved is unknown, but it appears to be a not inconsequential quantity. Swordfish regularly appears on menus at some restaurants. Puerto Rican cooking books now appear with swordfish recipes. The companies buying this swordfish process the trunks into center cuts (ruedas), and fillets.[339]

Only a small number of companies handle swordfish and tuna in Puerto Rico. Companies have to obtain permits from NMFS to handle swordfish and tuna that is caught by a U.S. fisherman.[340] This is part of the management program developed for these heavily fished species. Two Puerto Rico companies (Fresh Fish and Tommy Forte) have swordfish dealer permits (appendix E2a). Three companies (Caribbean Seafood Industries, McAuliffe, and S&P Seafoods) located on the Virgin Islands have swordfish permits. These companies handle the swordfish landed by the U.S. longliners. Nine Puerto Rican companies had tuna permits in 2001, all located in the northwestern ports where artisanal fishermen target oceanic pelagics (appendix E2b).

One of the concerns of U.S. buyers is that swordfish not have a prominent dark bloodline. Many buyers reject these fish because some consumers do not like to see these bloodlines. Fish with dark bloodlines can sell for lower prices. The fishermen insist that fish with dark bloodlines can be as fresh and tasty as those without them.[341] This is not a problem unique to Puerto Rico, but is does appear to be a more common problem with fish caught in tropical waters.

U.S. fisherman have speculated on the cause of these pronounced bloodlines.

Super-chilling: One U.S. fisherman who operated longliners from San Juan has commented on this problem. They attributed the dark bloodlines to "super-chilling". He found that fish that had become frozen, because it was at the bottom of the hold, frequently had dark bloodlines. A U.S. longliner may be at sea for 2 weeks. The fish caught during the first few days are thus at the lowest lawyer of the hold. The ice and fish at the bottom may become compressed with the weight of subsequent catches and some freezing may take place. Some fishermen addressed this problem by having ice "rest" for several days before leaving on a trip or using freshwater ice (which is not as cold)

Spawning: Some fishermen have noted fish with dark bloodlines, regardless of when the fish was taken during the trip. One U.S. fisherman reported that fish during the spawning season commonly have dark bloodlines.[342] Swordfish return to the wider-Caribbean to spawn after feeding on rich northern grounds. As a result, pronounced bloodlines during spawning, can be an especially serious problem for Caribbean-based longline operations.[343] Longline fishermen operating in the Caribbean who brings back a lot of fish with dark bloodlines can have their earnings impaired.

XI. Organizations

A. Companies

The Puerto Rican fisheries catch is quite small. (See: I. "Overview".) The relatively small quantities of fish landed by the fishermen mean that there is no need for large companies. Substantial quantities of the catch is in fact sold fresh at the dock or beach by the fishermen themselves.[344] Other fishermen have arrangements with dealers who handle their fish. The authors know of no local companies which operate commercial fishing vessels and are aware of only a few companies which process or market seafood in any significant quantity, with the exception of the Mayagüez and Ponce tuna canneries described above. (See: "X. Processing.").

Only a few Puerto Rican companies handle swordfish or tuna. Several appear to be very small companies without even a listing in directory assistance. Apparently some fishermen have applied for dealer permits so that they can retail their tuna catch. Very small quantities of tuna may be involved in some instances. The fact that many of the companies are so small has made it difficult to obtain information about the companies.

Available information on Puerto Rican based companies or companies that have operated on the island is as follows:

Andy's Foods: This is a typical San Juan fish retailer. Some of the popular species they handle are snapper ("chillo"), grouper, salmon, octopus, and lobster. They do no handle tuna or swordfish. All of their seafood is imported product sourced from India, Thailand, Colombia, Dominican Republic, and other foreign countries. They do not but from local fishermen. They offer frozen product.[345]

(Tommy) Forte: Tommy Forte is one of the more established seafood dealers on Puerto Rico. The business is situated at the Centro Pesquero of Santurce where he has operated since 1980. The owner was a fishermen who switched to marketing fish in 1985. The Tommy Forte company in 1998 acquired a swordfish dealer permit. They also had a tuna dealer permit in 2001. Much of the fish which they distribute comes from the bycatch of the San Juan-based mainland longliners. He purchases tuna, dorado, swordfish, and other species from the U.S. fishermen. He also buys some fish from the local artisanal fishermen, but the mainland longliners are his primary source of fresh fish. Fishermen when they bring in a catch call the company which operates on a 24-hour basis. He also imports frozen fish to meet specific requirements from hotels and restaurants. The company reports increased competition with other seafood distributors in recent years. He reports the following seasonal supply: dorado (December to March), shark (all year round), swordfish (November-May), and tuna (May-June). The company also assists the mainland longliners ship their swordfish catch to the mainland United States. The fish is already headed and gutted when landed, the company packs the swordfish trunks in insulated cardboard boxes and then trucks them to the airport in refrigerated trucks. The company reports that swordfish and tuna are readily available from fishermen, but some species supplied by the artisanal fishermen (especially lobster) are increasingly difficult to obtain.[346]

Fresh Fish Company: José Colón has founded this new company. He is one if the few Puerto Rican fishermen to longline commercially. He began longlining in 1985, taking tuna and swordfish with a 80-km line with 1,000 hooks. He now focuses on marketing. Colón used to work for Tommy Forte, but decided to launch his own company. The Fresh Fish Company is located in Rio Piedras/San Gerardo. The company acquired NMFS swordfish and tuna dealer permits in 1999. He is primarily interested in tuna and swordfish, but also handles a lot of dorado. The tuna and dorado come from local artisanal fishermen and the swordfish is purchased from the U.S. longliners in San Juan. He also imports product. The local fishermen started landing more fish in 1998 and Fresh Fish has substantially increased the quantity of fish handled in recent years. The local retail market is generally supplied from imported fish. Fresh Fish primarily sells to Sea World which distributes to seafood restaurants. They provide high-quality product including tuna and swordfish as well as a variety of bycatch species. The product handled is highly seasonal. The largest quantities are marketed from November to May when the mainland fleet is most active. The 2000-2001 season was a little slow as fewer U.S. longliners have been operating out of San Juan. This has substantially reduced the quantity of tuna and swordfish available.[347]

Kali Seafood: This Puerto Rican company conducted experimental fishing operations in the Caribbean during the early 1980s. The operations were partially funded by NMFS with S.K. funds. As a result of the trials, Kali reported developing a demersal longline technique for artisanal fishermen.[348]

MacLean's Seafoods: MacLean's Seafood is one of the larger U.S. companies that has been involved with the longline fishery out of San Juan. The company is

located in Fairhaven, Massachusetts and has traditionally handled the swordfish catch of U.S. vessels operating off the northeast coast. When the fishermen moved south in to the Caribbean, MacLean's continued to buy the fish. Thus they were active in San Juan when U.S. longliners fished extensively out of the port. MacLean's loaded the fish and flew them back to Boston. They only handled fresh product. Most of their fish is flown in within 12-24 hours of being unloaded. MacLean's also imports swordfish from several different foreign countries.[349]

Marisquería Atlántica: This company is located in the Puerto Tierra neighborhood of San Juan. They both sell fish and operate a seafood restaurant. Some of the major species they handle are snapper ("chio"), dorado, tuna, swordfish, and octopus. The company mostly handles fresh product, but some species like octopus is frozen. They also offer imported product and Spain and Chile are major sources.[350]

(La) Mercedith: This Aguadilla company in 2001 had a tuna dealer permit. There is no listing, however, in the yellow pages or with directory assistance.

Northwestern-Select: This is one of the largest Puerto Rican meat dealers, but they also handle seafood. The company reports that their seafood is all imported frozen product. The principal species are grouper, kingfish, salmon, dorado, snappers (scarlet, yellow tail, and lane), halibut, whiting, cod, pollock, octopus, shrimp (marine black tiger and freshwater), conch, crab, and lobster. They have three processing plants which primarily produce steaks (grouper, kingfish, and salmon) and portion control dorado fillets. This is packed for both the retail and food service trade. The company has two divisions. The first supplies retailers like supermarkets and smaller "mom and pop" retailers. The second supplies food service establishments, including restaurants, cafeterias, hospitals, prisons, schools, etc. The company is headquartered at Puerto Nuevo in San Juan and has several outlets located throughout the island.[351]

Pacific Food Products: This wholesaler handles meat and poultry as well as seafood. The seafood division is El Pescador.

(La) Pescadería: This Rincón company in 2001 had a tuna dealer permit. There was no listing for this company available from directory assistance. Several fishermen set up small companies to obtain NMFS tuna dealer permits. This may be one such operation.

Pescadería Ambulante: This Aguada company in 2001 had a dealer permit. Several fishermen set up small companies to obtain NMFS tuna dealer permits. This may be one such operation. The name suggests that the company is a mobile peddler. There is, however, no listing in the yellow pages or with directory assistance.

Pescadería Atlántica: This company is located in the Savanática neighborhood of San Juan. They are involved in wholesale/retail sales of seafood. Most of the product sold is fresh, whole dressed fish. They do not process any seafood. Some of the stores, however, have attached restaurants. The company is reportedly one of the largest seafood dealers on Puerto Rico. They primarily handle fresh product.[352] Some of the principal species handled are grouper, snapper ("chio"), salmon, halibut, hake ("merluza"), dorado, tuna, and swordfish. They supply restaurants, supermarkets, and hotels. Most of the product is obtained in the United States. They do not buy from local fishermen or the mainland longliners in San Juan.[353]

Peacadería Plaza: This Aguadilla company in 2001 had a tuna dealer permit. There is, however, no listing in the yellow pages or with directory assistance.

(El) Pescador: This San Juan dealer provided seafood to restaurants and hotels. They offer a variety of species including dorado, king mackerel ("sierra"), octopus, and others. They only handle imported frozen product. Major suppliers are the United States (New England) and the Philippines. Must of their product is fillets.[354] The company is a subsidiary of Pacific Food Products.

Rios Irrizary, Rafael: This Aguada distributor in 2001 had a tuna dealer permit. There is, however, no listing in the yellow pages or with directory assistance.

(Tomas) Rosas: This fisherman operated a small fleet of 5-10 boats, 10-12 m in length, from west coast ports. This was one of the few operations to venture beyond coastal waters. A few seizures were reported by Dominican and Bahamian authorities. He did not, however, target oceanic pelagics.

Sea World Incorporated: This seafood company is primarily a distributor, but they do some limited processing, including fillets and other desired cuts. Sea World, according to one local observer, is the largest supplier of high-quality seafood to Puerto Rican restaurants and hotels. They also sell to supermarkets.[355] One observer estimates that they supply nearly 70 percent of the seafood purchased by restaurants. Sea World has outlets located all over the island, but the primary market is San Juan. Most of their product is imported from the United States, especially Boston, but there are also some imports from Spain, Chile (salmon), Costa Rica (dorado) and other countries. Only small quantities of fish is purchased from local fishermen, because of the limited supply and seasonal availability. Sea World handles a wide range of species, including grouper, snapper, dorado, tuna, halibut, shrimp, lobster, crab, squid, and other species.[356] The company in 1995 reportedly marketed approximately 14 t of swordfish in Puerto Rico.[357] They offer a wide range of seafood, including sushi delivered under strict temperature

controls. The company handles both fresh and frozen product, but about 80 percent of the seafood handled is fresh. Frozen product is mostly shrimp, lobster, and a few other high value species.

Vendedor Ambulante: This Aguadilla vendor in 2001 had a tuna permit. The name suggests that the company is a mobile peddler. There is no listing in the yellow pages or with directory assistance.

Others: There are also reportedly several small informal dealers which may buy small quantities of fish from both local artisanal fishermen and the mainland longline fishermen. These dealers have developed purchase arrangements with the fishermen who may even inform them when they are landing fish. Sales methods and clientele vary widely.

B. Associations

A substantial number of Puerto Rican artisanal fishermen belong to fishermen associations. The associations were established by Community Action programs promoted by the Puerto Rican Department of Labor. A 1988 report indicated that about 40 percent of Puerto Rican fishermen were members.[358] Congreso de Pescadores officials report that in 2001, about half of the island's 2,000 fishermen, both full and part-time, belonged to the associations. There are currently about 40 such associations in Puerto Rico.[359] Many fishing centers/communities have their own associations. The initial idea was for the associations to act as cooperatives, helping members market their catch. Results have varied widely among the various associations. CP officials indicate that the associations provide many other services such as help in acquiring improved boats and gear.[360] The associations also offer facilities like lockers that are useful in securing gear and equipment close to the boats and landing areas. The associations with the support of the CP help keep members informed of government management regulations as well as represent the fishermen in meetings with regulatory agencies. The associations also provide a variety of social and other benefits.[361] The substantial membership of the associations is an indicator that fishermen find the variety of services offered to be beneficial.[362]

The authors have little available information on individual associations. The fishermen are primarily involved in artisanal fishermen targeting reef fish with small boats. Only a few associations have expressed interest in pelagic fisheries.

Congreso de Pescadores: Fishermen with government assistance organized the Congreso de Pescadores (CP) in 1989. It has become the main advocate for the artisanal fishermen organized into associations. One of the CP's primary functions is to support the fishermen's associations around the island. The CP is currently promoting the acquisition of improved technology and larger boats which will enable the fishermen to operate off the island's heavily fished shelf. They are acquiring a large boat (about 15 m) which they plan to deploy in test fishing operations. They are encouraging the Commonwealth Government to increase its $50,000 annual grant so they can provide more assistance to the member associations.[363]

Asociación de Pescadores de la Villa del Ojo: This association is one of the oldest and most successful fishermen's association on Puerto Rico. It was formed in 1974 and in mid-2001 had 38 full-time members. Counting both full and part-time members, there are about 100 boats that work with the association. The association does not charge a membership fee, but members pay a fee of 5 percent of the value of their catch to maintain the association, equipment, ice, and operating expenses. The members generally fish about 15-25 km off Aguadilla and Rincón. Much of the catch of its members is tuna for which the fishermen have to obtain NMFS permits. They also take demersal fish like red snapper ("chillo") and yellowtail ("colirubia"). The association processes about 9 t of fish

Photo 32.--Fishermen's associations are still active at several different landing sites. This sign advertises the Fishermen's Association at Crashboat. William Folsom

monthly. They only process the catch of their members. If catches have been good the association is unable to process all of the members' catch because of the limited processing capacity. Processing includes cleaning and gutting the fish and producing fillets and steaks. They have two small walk-in freezers ("cogeladores") and three chillrooms ("neveras"). They market the fresh fish landed by members, but often report difficulty selling fish if catches have been particularly good. One of their important clients is Starkist. The association is located at Crashboat, a beach along the northern-eastern coast. The association does not currently have a NMFS tuna dealer permit, but is applying for one.[364]

Asociación de Pesca Bo Jar: This Arecibo-based association in 2001 had a tuna permit. This appears to be the only Puerto Rican fishermen's association with a NMFS tuna dealer permit, although another association was working on one. The quantity of tuna they handle is relatively small.

Other associations: The Congreso de Pescadores reports that there are a total of 40 fishermen's associations in Puerto Rico. Most of the associations are small, averaging about 40 members. The authors have received varying reports on these associations. Many of these associations, are not very active. In some cases they are primarily run by a single active individual. Other observers say they are small associations whose members land only limited quantities of fish. None of these associations, except the two specified above, have tuna permits.

XII. Markets

A. Domestic

Seafood is popular in Puerto Rico, especially cured cod and fresh seafood. One survey indicated a very strong propensity for fresh over frozen product, about 95 percent of consumers interviewed said that they prefer fresh fish.[365] One San Juan retailer reports that seafood in Puerto Rico is growing in popularity.[366] Another retailer says that seafood in recent years has developed a quality image. Consumers are willing to pay more for seafood than less expensive alternatives like chicken. This retailer also reports that frozen seafood is becoming increasingly acceptable to the Puerto Rican consumer.[367]

Photo 33.--Much of the domestic Puerto Rican catch is sold at the docks or on the beach as the fishermen unload their catch. Here customers inspect the snapper catch of an artisanal fisherman. William Folsom

1. Overall market

Observers estimate that Puerto Rican fishermen supply only a fraction of the seafood consumed on the island. Puerto Ricans consume about 9.1 kg of seafood annually. One local observer estimates imports at nearly 30,000 t and believes that only about 5-10 percent of that seafood is supplied by the local fishermen (appendix E1).[368] Thus the great bulk of the seafood consumed in Puerto Rico is imported. U.S. import data shows that non-tuna imports from foreign countries are normally 10,000-15,000 t (appendix F1a). Even greater quantities are believed to be sourced in the mainland United States.

Most Puerto Rican fishermen either sell their fish to a fish broker, through an association, or peddle it themselves in local communities. Many use multiple sales methods. Smaller numbers sell to restaurants or through their own businesses, usually a fish store or seafood house.[369] Marketing patterns do appear to be changing. Peddling has declined and more efficient channels such as sales to associations and restaurants, or even through self-owned business have increased substantially.[370]

Seafood in Puerto Rico is available at four types of retail outlets. Unlike most Caribbean islands, fish is often not available in Puerto Rican central markets ("plazas del mercado"). Much of the fish caught by artisanal fishermen is landed along the southern and western coasts and is directed at local and regional markets close to the western and southern landing sites and thus does not enter the San Juan market. The large San Juan market is primarily supplied from U.S. mainland sources and imports. The bycatch of the mainland longline fleet has also been an important source, but fewer mainland longliners have been deployed from San Juan in recent years (appendix A2b).

Landing sites: Fish can be purchased at the various centers where the fishermen land their catch. These sites, however, are mostly located at some distance from the major urban center (San Juan) where about one-third of the island's population resides. Only limited quantities of the domestic catch (landed at the major western and southern landing sites) are marketed in San Juan. domestic landings are mostly sold at the landing site for local consumption or to brokers who distribute it in nearby cities (especially Ponce and Mayagüez). Swordfish is rarely available, but small quantities of locally caught tuna are often available.

Hotels and restaurants: Hotels and restaurants in Puerto Rico offer a wide variety of both imported and locally caught fish. Tourism is Puerto Rico's second most important industry (after manufacturing). The

tourist industry is mostly centered in San Juan. Much of the swordfish consumed in Puerto Rico is sold at restaurants catering to tourists. Many of the better restaurants, especially those specializing in seafood, often offer swordfish on the menu. Less expensive shark meat has become popular with Puerto Rican consumers in recent years. Shark meat served as shish-kebabs ("pinchos") is a popular local treat.[371]

Supermarkets: Much of the fish sold in San Juan and other urban centers is sold at supermarkets. The principal chains are: Xtra, Grande, and Amigo. Many of the larger supermarkets in San Juan have in recent years added fresh fish counters. Supermarkets handle both imported (mostly frozen, but also some fresh) fish and small quantities of locally caught fresh fish. Most of the fish, however, is imported from foreign countries or purchased in the mainland United States.[372] The supermarkets need a reliable supply of the same species. The local catch is highly variable, both the quantity and the species. Thus most supermarkets rely primarily on U.S. mainland or foreign suppliers.[373] Swordfish is frequently available in the larger stores, especially those with fresh fish counters. The product is either purchased from the mainland longliners landing their catch at Isla Grande or from U.S. mainland and foreign sources.

Seafood stores: The authors have noted a few Puerto Rican retail outlets specializing in seafood. Many of these are located in the San Juan area. There were 15 such listings in the 2001 yellow pages provided by the CFMC, but many were not operating with the authors attempted to contact them. There are probably a few additional newer retailers who are not listed. Some of the larger distributors such as Pescadería Atlántica and Sea World have retail outlets.

Some observers believe that the tourist industry has adversely affected the fishing industry and the supply of fish to the domestic market. Some fishermen have reportedly found they can earn more money through a variety of tourist activities.[374] The authors note, however, that since many observes believes coastal stocks are being heavily fished, it does not appear that the shift of some fishermen to tourist activities has had a substantial impact on production.

Another problem the Puerto Rican fishermen report is the highly seasonal nature of the fishery. Fishermen report their highest catches from June to August and November through January. The claim that they could catch more fish during this period, but that the local market would not support a major spike in production during those months. Wholesalers have to limit their purchases during those months. Some product can be sold to canneries, but at prices well below that normally received by the fishermen.[375]

Given the large quantities of seafood being imported, the authors are unsure how to interpret these apparent marketing problems. It is possible that some major buyers prefer to import because of a more consistent year-round supply. Other factors such as quality, price, and species diversity are also involved.

Puerto Ricans consume a wide variety of fish, but many prefer an imported species--cod.

Cod: Surprisingly, one of the most popular fish in Puerto Rico is cod, a north Atlantic species not found in Caribbean waters. The fish is in part popular cod because many traditional Spanish dishes require cured/salt cod. It was, however, during the 1930s that cod came to dominate the local market. The price for cod fell during the Depression of the 1930s. Cod became the most inexpensive source of protein available. It was used to make many different dishes which became an important part of Puerto Rican traditional cuisine. Even though prices for cod eventually increased and are now quite expensive, many Puerto Ricans still prefer it to locally caught fresh fish.[376] All of the cod consumed in Puerto Rico is imported, at considerable cost.

Native species: Most other popular species are local ones. Some of the most popular species are tunas, snappers, groupers, lobster, and conch. Sharks which are taken incidentally in longline operations are becoming increasingly accepted in the local market. Most of the imported product comes from the Gulf of Mexico where the species mix is similar to the Caribbean.[377]

2. Swordfish

Swordfish constitutes only a tiny proportion of the overall seafood market in Puerto Rico. Only small quantities of swordfish are sold on the island. Swordfish has not traditionally been available in Puerto Rican markets.[378] Swordfish is now, however, commonly available in the supermarkets with fresh fish counters as well as the small number of fish stores on the island.

The authors believe that a part of the domestic sales are associated with the island's tourist industry. Travel literature describe "huge" swordfish dinners.[379] Fresh swordfish and tuna have also become fashionable with the island's affluent middle class.[380] Many restaurants offers swordfish dishes.[381]

Most of the swordfish marketed in Puerto Rico is the fish landed by the U.S. mainland longline fishermen. One local estimates that about 10 percent of their catch, primarily the lower quality fish, is sold

locally to restaurants and hotels.[382] One local dealer confirms that he buys from the mainland longliners, but denies that he markets lower quality product, insisting that he only handles the highest grade product available.[383] Another dealer also confirms that he relies heavily on the mainland-longliners based in San Juan for their pelagic species. He reports that the mainland fishermen commonly sell their bycatch to local dealers.[384] Puerto Rico's artisanal fishermen, much as Cuban artisanal fishermen, have landed small quantities of marlin and swordfish. One local seafood businessman estimates that about 35 t of swordfish is being marketed on the island annually.[385] Other observers believe the quantities involved may be even less.[386] Some of this swordfish is purchased through fish brokers at San Juan (Isla Grande) where the mainland longline fishermen land their catch and the rest is purchased in the U.S. mainland or imported. Some fish may in fact be landed in San Juan, shipped to the U.S. and then purchased in Miami or other U.S. markets for final sale on the island.[387]

While only limited quantities of swordfish are sold in Puerto Rico. The authors note a variety of swordfish dishes, some of which are described as traditional food. These are probably not traditional dishes as Puerto Rico's artisanal fishermen have not historically landed swordfish. These dishes appear to longline fishermen and the small local longline fleet began to land swordfish. Even some restaurants stressing locally available foods currently offer swordfish.[388] Interestingly, Puerto Rico is virtually the only Caribbean island which has distinctive swordfish dishes.[389] One book of traditional cooking or "comida criolla" provides a recipe for Puerto Rican swordfish ("Pez espada Boricua").[390] A basic internet search brings out a variety of Puerto Rican swordfish dishes such as swordfish marinated in recaito or swordfish broiled on a sugarcane skewer.

B. Trade

1. Exports

Puerto Rican fishermen export very little fish. During many months the local market absorbs most of the catch. Industry groups would, however, like the Government to assist them find export markets for the surplus fish being landed during the peak season, including shark, tunas, dorado, bonito, sierra, and other species.[391] Puerto Rican companies have received inquiries from foreign countries about the availability of fresh fish. One company reports shipments to Japan (fresh tuna and bonito) and Chile (fresh tuna).[392]

Almost all of the swordfish landed in Puerto Rico is immediately shipped fresh to U.S. markets. Small amounts are directed to the limited domestic market. (See: "XII. Markets: Domestic" above.) The authors know of no significant exports to foreign markets. There may be, however, small occasional sales to other Caribbean islands.[393] Such shipments appear to be very limited and do not appear in official U.S. export data.[394]

2. Imports

Puerto Rico is not self sufficient in seafood. Seafood is imported, but much of it is tuna destined for canning (figure 5, appendix F1a). Smaller quantities of seafood for the domestic market are purchased in the mainland United States, but this is not actually an import as Puerto Rico is part of the United States. Much of the fish available in super markets is purchased in the mainland United States or imported from foreign countries.[395] For most seafood distributors, the United States is the primary supplier, but imports from Spain, Costa Rica, Chile, and other countries also occur. Imports are extensive both because of the limited quantities available from the local fishermen and the seasonality of supply.[396]

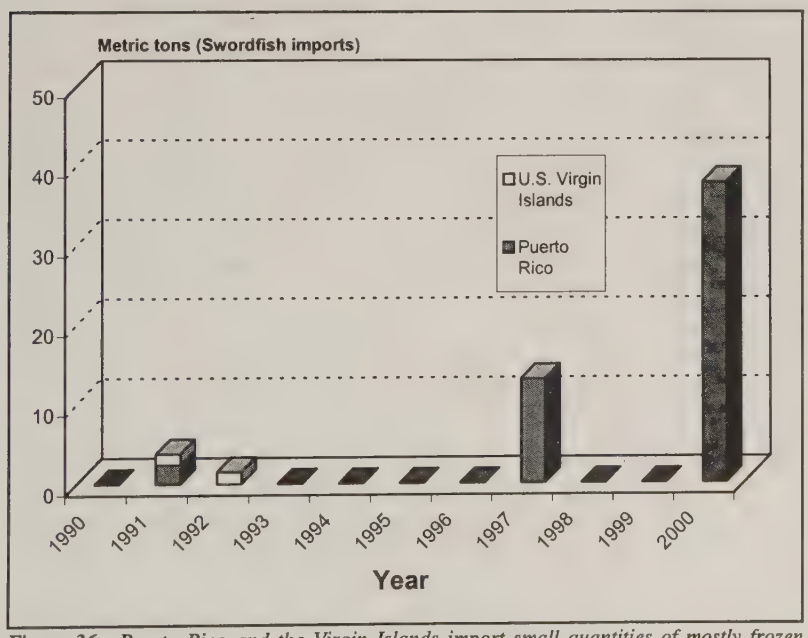

Figure 36.--Puerto Rico and the Virgin Islands import small quantities of mostly frozen swordfish. Shipments in 2000 were the largest ever imported.

Puerto Rican companies also purchase small quantities of swordfish from U.S. mainland as well as foreign suppliers. These purchases have been increasing in recent years, in part because of the sharply reduced number of mainland longliners that have been using San Juan.

Mainland longliners: Swordfish was introduced to Puerto Rico by the mainland longliners that operated out of San Juan. While most of the swordfish and tuna was transhipped on to the States, some swordfish and tuna, as well as bycatch species were marketed locally. The operations of the mainland longliners since the mid-1980s has helped create a market for these species on the island.

Mainland sources: Puerto Rican distributors buy mostly fresh swordfish in the mainland United States (Boston and New York). Purchases from the mainland United States are not precisely an import, as Puerto Rico is a U.S. Commonwealth. Swordfish may also be obtained from Miami suppliers. The fish landed in San Juan by the mainland longliners for sale in the local market, even though it was a small part of the catch, helped to create a market for swordfish in Puerto Rico. Since most of the longliners no longer call at San Juan, the market has to be supplied by mainland purchases or imports.

Imports: Puerto Rican distributors have also imported swordfish, mostly frozen product. Until 2000, the quantities involved have been small and irregular. This product has been sourced in several different countries. Most of the swordfish imports are Chilean but also small amounts are also imported from Japan.[397] It is difficult to track the amounts as some of this product is apparently imported through mainland customs districts and then shipped on to Puerto Rico. Direct imports through the U.S. San Juan Customs District have been limited. U.S. Customs did note, however, direct shipments of 2.4 t worth $8,000 during 1992. No other direct shipments were reported until 1997 and even larger shipments have occurred in 2000 and 2001 (appendix F2a). This may be the result of reduced landings by the mainland longliners. Imports totaled nearly 40 t in 2000, but this was an unusually large quantity. Most of the 2000 imports were frozen fillets imported from Ecuador, but there was a small unspecified shipment from Peru, probably trunks. Even larger quantities are being imported in 2001. Import shipments for only the first half of the year totaled 34 tons.

XIII. Government Policy

Fisheries in Puerto Rico are a shared responsibility between the Commonwealth and U.S. Federal Governments. Commonwealth and Federal agencies cooperate closely in fisheries management.[398] Puerto Rico is also represented on the U.S. Caribbean Fisheries Management Council (CFMC) which formulates fishery management plans.

Inland/coastal: The agency responsible for inland and coastal fisheries in Puerto Rico is the Departamento de Recursos Naturales y Ambientales (DRNA) which assumed the functions of the Corporación para el Desarrollo y Administración de los Recursos Marinos, Lacustres y Fluviales de Puerto Rico (CODREMAR) in 1990. CODREMAR, the former Commonwealth fisheries agency, had been established in 1979 and administered Puerto Rican fisheries during the 1980s.[399] CODREMAR was a DRNA unit. The Puerto Rican Department of Agriculture (PR-DA) also has some interest in fisheries, primarily administering landing facilities and markets.[400]

Marine: The U.S. Federal agency responsible for marine fisheries is the National Marine Fisheries Service (NMFS). NMFS is a unit of the National Oceanic and Atmospheric Administration (NOAA) which is part of the U.S. Commerce Department.

A. Fishery laws

1. Federal

Consistent with requirements of the Magnuson-Stevens Fishery Conservation and Management Act and the National Standard guidelines, NMFS seeks to manage highly migratory species (HMS) fisheries for optimum yield, rebuild overfished fisheries, and reduce bycatch and bycatch mortality to the extent practicable.

a. Legal authority

The principal U.S. law governing fisheries throughout the United States (including Puerto Rico) is the 1976 Magnuson-Stevens Fisheries Conservation and Management Act (FCMA), which has since been amended numerous times. Several other laws and regulations affect U.S. swordfish fisheries.

ATCA: The Atlantic Tuna Conventions Act (ATCA) is the legal authority for implementing ICCAT regulations in the United States. The ATCA gives NMFS the authority to develop domestic regulations to implement international management regimes ascribed to as part of U.S. treaty obligations.[401] As a result, the pertinent Federal regulations include state (3-12 mile waters) or in the case of Puerto Rico Commonwealth waters (9 nautical miles). This differs from the Federal management regime for most other species which do not cover state/commonwealth waters.

ESA: The Endangered Species Act (ESA) protects endangered or threatened species. Swordfish itself is not endangered, however, some species taken incidentally in both longline and drift net operations, such as sea turtles, are endangered.

FCMA: The Magnuson Fisheries Conservation and Management Act (FCMA), enacted in 1976, gives the U.S. Department of Commerce the authority to manage marine fisheries.[402] The FCMA establishes regional fishery management councils (FMCs) to participate in the process by preparing fishery management plans (FMPs). The council responsible for Puerto Rico and the USVI is the Caribbean Fisheries Management Council (CFMC) based in San Juan, Puerto Rico. Under the authority of the FCMA, the CFMC has prepared FMPs for four Caribbean fisheries: spiny lobster (1985), reef fish (1985), corals (1995), and queen conch (1997). NMFS has prepared FMPs for three other fisheries involving the Atlantic coast, including Puerto Rico and the USVI: swordfish (1985), billfish (1988), and sharks (1993). NMFS revised the regulations in 1999 with an combined HMS plan (tuna, swordfish, and sharks) and a separate billfish plan. The CFMC is now working with the Gulf and South Atlantic FMCs on a tri-council FMP for dorado (dolphinfish) and wahoo.[403]

Nicholson Act: The Nicholson Act prohibits foreign fishing vessels from landing their catch in U.S. ports.[404]

FDA regulations: The Food and Drug Administration (FDA) is responsible for guaranteeing the health and safety of food consumed in the United States. The FDA in 1971 restricted the amount of mercury found in seafood to 0.5 parts per million (ppm). Swordfish as an apex predator, accumulates mercury more than most other fish lower in the food chain. Few swordfish could meet this high tolerance level and imports were significantly restricted. After a court challenge, FDA raised the tolerance level to 1.0 ppm which allowed significant imports to resume. FDA currently requires that all imported swordfish be treated as mercury-contaminated until proven otherwise.[405] The only available testing facility for checking mercury levels, however, was in Atlanta, Georgia. It took about 10-14 days to ship the fish, conduct the tests, and receive the report. Foreign caught fish must thus be frozen and held until test results are available. This reduced the value of the catch. The FDA has since

speeded up their testing process. The FDA regulations, however, in the early 1990s discouraged U.S. fishermen operating in the Caribbean from transhipping through the USVI.[406] During the early 1990s, FDA was treating fish landed by U.S. fishermen in the USVI identically as imported product because the USVI is outside the U.S. Customs Area. This significantly curtailed landings in the USVI, but not Puerto Rico which is included within the U.S. Customs Area (appendix D3b). The FDA import alert which treated all imported swordfish as mercury-contaminated until proven otherwise.[407] FDA has since modified its rulings and currently treats fish landed by U.S. fishermen in the USVI the same as landings in other U.S. ports. Since Hurricane Marilyn struck the USVI in 1985, however few U.S. mainland longliners have worked there.[408]

b. Management regime

Fishery management plans provide a strict fishing regime for swordfish and related species taken in the pelagic longline fishery. The regulations on swordfish and billfish do not significantly affect Puerto Rican fishermen as they rarely land these species. Artisanal fishermen, however, would like an exemption to cover the small number of swordfish and more commonly billfish that they occasionally catch.

1) Swordfish

Strict Federal regulations closely regulate swordfish fisheries. NMFS works closely with the International Commission for the Conservation of Atlantic Tunas (ICCAT) to manage this heavily fished stock. As Puerto Rican fishermen do not target swordfish or take appreciable numbers, these regulations mostly affect the mainland U.S. fishermen that operate seasonally out of San Juan.

1985: NMFS implemented the first fisheries management plan (FMP) for Atlantic swordfish in September 1985. The plan included Puerto Rico as well as the mainland United States. The FMP sought to: 1) enhance the economic value of landings by reducing the harvest of small swordfish; 2) prevent or reduce growth overfishing and recruitment overfishing; obtain scientific information for monitoring the fishery; and 4) monitor and mitigate user group conflicts; and 5) minimize the impacts of foreign fishing on the domestic swordfish fishery. The 1985 FMP provided for:

Closures: Variable seasonal closures and annual adjustments to achieve optimal yields;

Fishing practices: Procedures for evaluating and restricting specific fishing practices;

Reporting: Mandatory statistical reporting.

1990-91: The ICCAT SCRS at its 1990 meeting recommended reducing the fishing mortality of north Atlantic swordfish weighing more than 25 kg by 15 percent from 1988 levels and prohibiting the taking and landing of swordfish weighing less than 25 kg live weight (125 cm lower jaw fork length). NMFS to implement the recommended ICCAT management regime issued a ruling on June 12, 1991, establishing:

Quota: An annual quota divided equally between January 1 - June 30 and July 1 - December 31.

Size: A minimum size limit of 78.7 cm dressed trunk (carcass) length or 18.6 kg weight. There was a 15 percent tolerance of undersized Atlantic swordfish--based on the number of swordfish taken per trip.

Bycatch: A bycatch limit of two swordfish per trip unless the vessel carries harpoon gear for which no bycatch is permitted.

Recreational: Prohibition on the sale of Atlantic swordfish taken by recreational fishermen and restricted recreational fishermen to rod and reel gear.

Observers: A requirement for some onboard observers.[409]

1996: NMFS implemented further ICCAT recommendations in 1996 with a rule dated June 4, 1996:

Quota: Reduced the U.S. total allowable catch (TAC) to 3,500 t (live weight).[410] The half-year time frame for the quota was changed to June 1 - November 30 and December 1 - May 31.

Size: Reduced the minimum size to 73 cm cleithrum to caudal keel measure or 15 kg trunk weight. Eliminated the 15 percent trip allowance for undersized swordfish.

Reporting: Made reporting requirements consistent with the logbook program.[411]

1997: NMFS identified Atlantic swordfish, blue marlin, white marlin, bluefin tuna, and 22 species of large coastal sharks as overfished in 1997.[412] Amendment 1 to the swordfish FMP was drafted in 1997. It included major changes in swordfish management, including proposals establishing eligibility criteria for participation in the swordfish fishery based on historical participation and specify rules for transferring permits.

1998: NMFS again identified Atlantic swordfish, blue marlin, white marlin, bluefin tuna, and 22 species of large coastal sharks as overfished. Bigeye tuna and spearfish were added to this list in 1998.[413] Amendment 1 proved highly controversial and in 1998 NMFS prepared an entirely new FMP for swordfish, tuna, and shark. The new proposed FMP was designed to significantly reduce fishing effort by limiting access to the fishery. It included a vessel monitoring system (VMS) for all pelagic longliners.

1999: NMFS made major changes in the regulatory regime with the implementation of a new FMP for

swordfish, tuna, and shark including limited entry provisions. NMFS also issued a final rule on February 4, 1999 restricting the importation of undersized Atlantic swordfish. The rule prohibits the import of Atlantic swordfish or swordfish pieces weighing less than 15 kg (33 lb) (dressed weight) unless an accompanying statement of eligibility indicates that the pieces came from a swordfish above the minimum size. Dealer permitting and reporting is required for all swordfish imports. Import shipments must be accompanied by a certificate of eligibility (COE). This new rule will facilitate the enforcement of the domestic minimum size regulation.

2000: A new VMS system included in the 1999 HMS FMP was initially scheduled to be implemented for Atlantic pelagic longliners during 1999. NMFS delayed implementation several times to respond to comments received from the fishermen. The fishermen had several objections to the VMS program including the cost and the wholesale nature of the requirement. They complained that NMFS had paid for the VMS devices in other fisheries. NMFS replied that it paid for the devices in some other fisheries because of the experimental nature of the program.[414] The U.S. District Court for Washington D.C. on September 25, 2000 put the VMS program on hold. As a result, NMFS has ordered an indefinite stay.

2001: NMFS is currently preparing a response to the issues raised by the fishermen to the VMS program in the District Court hearing and is undertaking further consideration of the scope of the VMS program as ordered by the Court. NMFS has requested options for implementing the VMS requirements in light of the costs to vessel operators and any relevant conservation requirements.[415]

2) Billfish

Federal regulations designed to better manage depleted billfish stocks prohibit the sale of billfish taken in the north Atlantic.[416] These limitations have frustrated Puerto Rican artisanal fishermen who very infrequently catch these species.[417] The artisanal fishermen have indicated a special interest in retaining the occasional billfish which they land.[418] Special exemptions were allowed for the Puerto Rican artisanal handline fishermen that occasionally took billfish. Swordfish was added to those exemptions in 1995. The exemption for artisanal fishermen, however, was ended in 1999 with the implementation of a new billfish management plan. This means that artisanal and commercial fishermen can no longer retain or sell billfish or swordfish that they may catch.

3) Tuna

Federal regulations also cover tuna fishing.[419] NMFS identified bluefin tuna as overfished in 1997. Bigeye tuna was added to this list in 1998.[420] Both artisanal and commercial fishermen must have permits to take tuna (appendix A5). The resulting catch can only be sold to permitted dealers (appendix E2b).

4) Integrated approach

NMFS, in late 1998, revised the objectives of HMS management and proposed the first-ever integrated fishery management plan (FMP) for Atlantic tunas, swordfish, and sharks. In addition, NMFS proposed Amendment One to the Atlantic Billfish FMP. These documents, the product of 2 years of work with constituent advisory panels and the general public, represent the formalization of joint management for these fisheries under both the Magnuson-Stevens Act and international management requirements. Major changes were made in the FMP and Amendment, responding to domestic legislative requirements as well as international recommendations. The results served as the groundwork for international negotiations for swordfish (1999) and billfish (2000) at ICCAT sessions. Management measures include, but are not limited to, gear modifications and time/area closures to reduce bycatch; limited access; permitting and reporting requirements; minimum size limits; and bag limits.[421]

2. Commonwealth

a. General

The principal Puerto Rican fisheries law remained the 1936 Ley de Pesca (Law 83) until 1998.[422] It was revoked and replaced with a new Fisheries Law (Law 278) in 1998.[423]

1966: The 1966 Programa Federal/Estatal de Investigación y Desarrollo Pesquero, Ley N°88-309 implemented the Commercial Fishery Research and Development Act of 1964.[424]

1970s: Several steps were taken in the late 1970s to promote fisheries, including the creation of CODREMAR.[425] (See: "D. Promotion" below.)

1987: Detailed regulations were issued on swordfish in 1987. (See "b. Swordfish," below.)

1990: Further major changes were made in 1990 with the elimination of CODREMAR, and the transfer of responsibility for fisheries directly to DRNA.[426]

1998: The 1936 Ley de Pesca by the 1990s had become badly outdated. The Legislature passed a new Fisheries Law (Law 278) in 1998.[427] Previously

existing fishery regulations have continued in effect while the DRNA is developing comprehensive new regulations to implement the new Law.

2001: The DRNA has drawn up a comprehensive set of new regulations which it has proposed implementing in 2001. A June 2001 executive session of the Puerto Rico House of Representatives, however, concluded that a new series of public hearings on the proposed regulations was necessary. They were scheduled to begin July 6 in Sta. Isabel, directed by Representative Roberto Cruz. The regulations are now in the final approval process.[428] Some of the major provisions include:

Artisanal: Local observers are especially concerned about the large numbers of permits issued to fishermen, only about 20 percent of whom actually use them.[429] Major changes are included in the new regulations dealing with matters such as: line length, number of hooks, size limits, and quotas.[430] There is also a new definition of full- and part-time fishing.

Artisanal longlining: The new regulations will limit longlining in Commonwealth waters to either 1 line 5 miles (8 km) in length or two lines 3 miles (nearly 5 km) in length.[431]

Mainland: One of the changes under consideration affects the swordfish fishery. Officials may require permits for the U.S. mainland longliners which Puerto Rican officials estimated were harvesting about $45 million of swordfish and substantial amounts of other species annually.[432] Mainland catches have declined significantly in recent years (appendix B3). The U.S. mainland longliners primarily operated outside Commonwealth waters. The limits on longlining of sets no more than 8 km long in the new regulations will essentially prohibit sets by the mainland longliners, as few will want to deploy a boat for such short sets.

Recreational: The new regulations have, for the first time, extensive provisions concerning marine recreational fishing.[433] Recreational fishermen will now have to obtain a Commonwealth recreational fishing licenses for activities within the 9-mile limit. Puerto Rican sport fishing regulations would not affect swordfish as they are not normally taken by the recreational fishermen. It will affect many other species which are not now covered by Federal regulations. In addition to the licenses are a comprehensive set of provisions setting bag limits, sizes limits, area closures, and many other restrictions. Special permits are required for conch, lobster, and seti (a juvenile goby caught as a traditional food item).[434] Puerto Rican officials report that the recreational fishermen have objected to any such licensing proposal.[435]

Almost all observers agree that the Puerto Rican fishery stocks are badly over fished. The new regulations to be implemented in 2001, although viewed with some trepidation by the fishermen, address many serious problems. The fishermen are moving from a regime of minimal regulations to a much more regulated environment. This will require some adjustment. The very low yields now reported by the fishermen have helped convinced many that a more regulated fishery is necessary. Some observers, however, are convinced that action is needed to reduce the large number of fish traps and lobster pots. This issue was not addressed in the regulations. It is an issue, however, that the CFMC plans to address.

b. Swordfish

The Puerto Rican Commonwealth Government issued detailed regulations on swordfish in 1987. The primary aim is to protect the resources targeted by domestic artisanal fishermen from the large commercial longliners deployed by the U.S. mainland fishermen. The Commonwealth regulations establish a variety of restrictions for fishermen targeting swordfish within Puerto Rican waters (9 nautical miles). The regulations require that everyone who is catching swordfish, except the extremely rare recreational catch, obtain a special Commonwealth swordfish fishing license. In order to obtain this license the fishermen have to register their vessel with the DRNA, indicate which gear will be utilized, and fill out a special form. The regulation establishes a swordfish fishing season from November 1 to March 31, thus closing the fishery April 1 to October 31. The regulation sets limitations on bycatch, gear, and fish sizes.

Bycatch: There is a bycatch limit of two of the following species per trip: dorado, king mackerel (sierra), and wahoo (peto). Catches in excess of the maximum two fish have to be returned to sea, dead or alive. The longliner fishermen must not keep any blue marlin.

Gear: The law states that the swordfish can only be taken with long-line and hook-and-line methods. The longlines can not exceed 8 kilometers. Recreational fishermen can only take swordfish using hook-and-lines.

Fish size: Juvenile swordfish (under 22.7 kg/50 lb dressed weight) must be returned to sea. Violations of the regulations can result in the seizure of the catch, vessel and/or fishing gear, and a penalty of up to $5,000 per infraction. The DRNA Secretary is empowered to set limits on the swordfish catch (fish per person per day). The regulations also limit commercial fishing operations within Puerto Rico's jurisdictional waters to U.S. citizens. This provision, however, does not apply to foreign citizens whose countries of origin have negotiated fishery access agreements with the United States. In order to protect

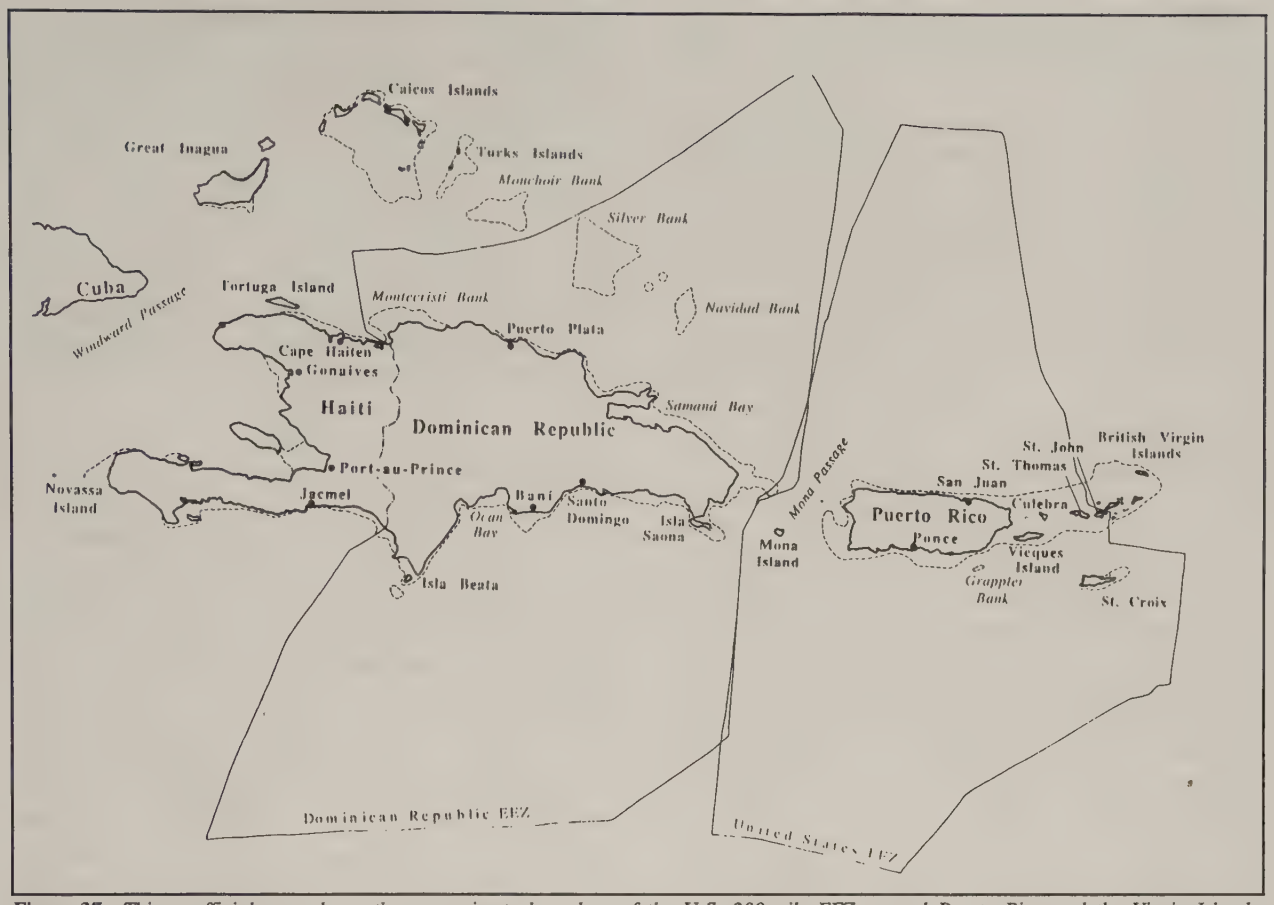

Figure 37.--This unofficial map shows the approximate boundary of the U.S. 200-mile EEZ around Puerto Rico and the Virgin Islands. Appeldoorn and Meyers

the local fishermen, non-Puerto Rican residents are not permitted to land their catch on the island for sale unless they obtain a special DRNA permit.[436]

Additional Commonwealth regulations on longlining are planned as part of the new regulations being prepared to implement the 1998 Fisheries Law. Proposals include limits on the length of sets. (See "Mainland" above.)

B. Limits

The United States established a 12-mile Territorial Sea in 1988 which also applies to waters around Puerto Rico.[437] The Puerto Rican Commonwealth Government has jurisdiction for fisheries within 9 nautical miles.[438] The U.S. FCMA established a 200-mile Exclusive Fishing Zone (EFZ) in 1976 which applied to territories including Puerto Rico and the USVI. The FCMA and other pertinent legislation gives the U.S. Federal Government jurisdiction for fisheries from 9-200 miles.[439] A Presidential proclamation in 1983 established a 200-mile Exclusive Economic Zone (EEZ).[440] A marine boundary agreement was signed with Venezuela on November 24, 1980.[441] An agreement with the United Kingdom was signed for both Anguilla and the BVI on November 5, 1993.[442] The United States signed the Part XI Agreement of the Law of the Sea Convention on July 29, 1994, subject to ratification. The Convention along with the Part XI Agreement was forwarded to the U.S. Senate for advise and consent to accession on October 6, 1994.

C. Permits and licenses

Federal regulations require U.S. fishermen to obtain a license for swordfish fishing. Several mainland U.S. fishermen have such licenses (appendix A3). No Puerto Rican fisherman currently holds a swordfish permit. Quite a number of Puerto Rican fishermen have general tuna permits, but none have tuna longline permits (appendix A5).

The Commonwealth Boating Commissioner's office registers all small boats on Puerto Rico. This includes recreational and commercial (including artisanal) fishing boats. Commercial and artisanal fishermen are only charged a registration fee of $5.00. If they have more than one boat, the registration fee

for the additional boats are based on the length of the vessel.[443]

These regulations well change with the recreational fishing licenses that are included in the proposed 2001 regulations implementing the 1998 Fisheries Law. Plans involve a variety of innovative approaches to making the licenses conveniently available to the public. The DRNA hopes to open kiosks in Wallmart and K-mart stores, presumably in the sports department, near the fishing tackle. The public will also be able to get their licenses by phone or over the internet. This would give Puerto Rico one of the most modern recreational licensing systems in the United States.[444]

D. Promotion

Government agencies began to promote the fishing industry during the 1940s. Several important fishery development steps have been taken since the 1960s. These steps included a variety of programs and initiatives to assist the fishing industry through expanded research, training and demonstration programs, design of model vessels, economic studies, construction of port facilities, and other actions.[445]

Research lab: The Laboratorio de Pesqueria Comercial (LPC) was established in 1964. (See: "XIV. Research.")

Federal aid: The Commonwealth Government decided in 1966 to participate in a U.S. Federal program to promote fisheries development by assisting state government agencies.[446]

CODREMAR: The Commonwealth Government in 1979 created the Corporación para el Desarrollo y Administración de los Recursos Marinos, Lacustres y Fluviales de Puerto Rico (CODREMAR). Fisheries promotion was one of the agency's responsibilities. The new agency helped to establish a fisheries extension service able to participate in the Federal Sea Grant Program which is administered by the University of Puerto Rico's Departamento de Ciencias Marinas at Mayagüez. CODREMAR provided an important training program for Puerto Rican fishermen. Critics of Puerto Rican fisheries policy contend that the Commonwealth Government, motivated by the island's chronic unemployment, have continued to promote expanding fisheries effort despite the limited available resource which was already heavily fished.[447] CODREMAR in the 1980s showed an interest in FADs.[448]

Boat loans: The Commonwealth Government through Puerto Rico's Department of Agriculture (DA) initiated the Fisheries Loan and Incentive Program in 1992. This provided low interest loans that allowed many fishermen to purchase their own boats.[449]

Training: The DRNA in 1999 began a training program preparing fishermen to diversify their operations away from heavily targeted reef fish and to more lightly fished pelagic stocks. Courses will included topics like navigation to enable the fishermen to operate at greater distances from the coast. The DRNA is working with the Congreso de Pescadores to prepare the training program.[450] The DRNA program is not without controversy. Some officials and fishermen believe that there is already considerable pelagic fishing and that what was needed is a seasonal closure ("veda") to reduce effort on reef fish.[451]

Puerto Rican pelagic catches are a small part of the island's overall fisheries catch (appendix D1c). Unlike the heavily fished inshore demersal stocks, pelagic resources appear to offer some opportunities for Puerto Rican fishermen. Pelagic species such as swordfish and a variety of others (shark, mackerel, tuna, squid, etc.) probably could support expanded effort. Some observers caution, however, that the potential of the available resource is not well understood and thus the optimal management policy would be to take a conservative approach toward expanding effort.[452] CODREMAR gave some attention to pelagic species. The CODREMAR training program included courses to help develop fisheries for oceanic pelagic species, including longline fishing and the use of fish aggregating devices (FADs).[453]

XIV. Research

The Puerto Rican research effort has focused on the demersal species of greatest interest to the local fishermen. research on pelagic species has been quite limited. Quite a number of agencies are involved with conducting or promoting fisheries research in Puerto Rico.

A. Efforts

The Puerto Rican research effort has focused largely on the demersal reef fish, and to a lesser extent pelagic species, of interest to the local fishermen. Some limited attention has also been given to costal pelagics. There has only been some research on oceanic pelagics, largely tunas and billfish (especially marlin). The Puerto Rican research effort is better funded and more extensive than that of most other Caribbean islands. Even so, basic information is limited on stock structure, migratory patterns, general dispersal and other topics concerning pelagic species. Much of the existing information is based on observations by fishermen and landing statistics.

The migratory pattern for several pelagic species off Puerto appears to be quite similar. They move in a westerly direction along the edge of the island shelf.
Little tunny: Little tunny is a schooling species that is some times found dispersed. It is present year round, but appears to migrate in a westerly direction.
Blackfin tuna: Seasonal concentrations of blackfin are reported around the northern Lesser Antilles and the eastern coast of Puerto Rico. It sometimes appears in skipjack schools. The species is most common on shelf areas at least 200-m deep. It moves along the edge of the shelf in a westerly direction.
Blue marlin: This important game fish is present off Puerto Rico all year round. Peak harvests are reported in August and September.
Dorado: Dorado occur in oceanic waters, but can sometimes be found in coastal waters. Fishermen report that it appears in numbers off Puerto Rico in November and can usually be caught through May. The largest schools usually occur in April. The fish migrate in a westerly direction and usually appear off the Virgin Islands about a month before Puerto Rican fishermen begin taking it. Some researchers report that there are a northern and southern stock.[454]
Mackerel: King mackerel begin to appear off the Virgin Islands in October and Puerto Rico in November. They appear off eastern Puerto Rico before they begin to be taken off the west coast. There are also solitary king mackerels present all year around reefs. Cero mackerel are most prevalent in the winter.[455]

There does not appear to have been any important Puerto Rican research on swordfish or the large oceanic pelagics.[456] This is understandable as these are not species heavily targeted by the Puerto Rican fishermen. NMFS has conducted some work on large oceanic pelagics, including swordfish.

B. Organizations

Important facilities conducting or promoting fisheries research in Puerto Rico include:
Caribbean Fisheries Management Council: The U.S. Caribbean Fisheries Management Council (CFMC) is based in San Juan. It is one of eight FMCs mandated by the FCMA in 1976. The CFMC is responsible for the U.S. territories in the eastern Caribbean (primarily Puerto Rico and the USVI). The CFMC prepares fishery management plans (FMPs) for important commercial and recreational fisheries.[457] The CFMC also promotes research on those fisheries. The CFMC has primarily worked on demersal resources, but did in the 1980s express an interest in working with the USVI and BVI to determine the total swordfish effort in the PR/USVI/BVI area. Data collected would have been used to assess the stock size.[458] Budget limitations, however, have not permitted the CFMC to pursue any such work on swordfish.[459]
CODREMAR: CODREMAR's fisheries research during the late 1970s and 1980s was conducted by the LPC. One topic addressed by CODREMAR was the impact of the mainland longliners which began to fish out of San Juan in 1984. CODREMAR by 1987 had drafted regulations for the Commonwealth Government.[460] The CODREMAR draft was the basis for regulations adopted by the Commonwealth Government in 1987. (See "XIII. Government Policy: A. Fishery laws".)
Commercial Fisheries Laboratory: See Laboratorio de Pesqueria Commercial (LPC).
Departamento de Agricultura: Puerto Rico's Agriculture Department (PR-DA) in the late 1960s and early 1970s sponsored an extensive program of exploratory fishing along much of the Puerto Rican coast. The trials included a wide range of gear. While longlining was not attempted there were tests using troll gear.[461]
FAO/UNDP: The fishery resources of the Caribbean were assessed during the late 1960s and early 1970s through the FAO/UNDP Caribbean Fisheries Development Program.

Grice Marine Lab: The Grice Marine Lab at the University of South Carolina conducts studies on a wide variety of species. Several of the studies involve Caribbean highly migratory species, like dorado. Researchers at Grice have taken samples of dorado for genetic testing.[462]

ICCAT: The International Commission for the Conservation of Atlantic Tunas (ICCAT) has attempted to obtain data from many Caribbean islands through its Enhanced Research Program on Billfish. The authors have no details on ICCAT activities in Puerto Rico, but IATTC works very closely with NMFS researchers, especially the Southeast Fisheries Science Center in Miami.

Jacksonville University: Jacksonville University is working in Puerto Rico through the Sea Grant program, but the project does not include swordfish or other oceanic pelagics.

Laboratorio de Pesqueria Commercial: The Laboratorio de Pesqueria Commercial (LPC) or Commercial Fisheries Laboratory is the primary Puerto Rican fisheries research institute. The LPC was opened in 1969 to monitor, describe, and promote the development of Puerto Rican fisheries. The LPC was created under the authority of Commercial Fisheries Research and Development Act of 1964 and cosponsored by the U.S. Interior Department and the Puerto Rican Agriculture Department. The LPC was administered by the Puerto Rican Departamento de Agricultura (PR-DA) before being integrated into CODREMAR, a DRNA unit, and the named changed to the LPC in 1979. The LPC has conducted a variety of exploratory surveys and gear tests. The primary gear taking oceanic pelagics tested by the LPC was troll gear.[463] CODREMAR was incorporated into the overall DRNA structure in 1990, the LPC was also integrated into the DRNA proper. LPC's activities currently consist of three divisions which: 1) collect and analyze fisheries data, 2) collect and analyze fisheries independent data, and 3) research the population dynamics of important commercial and recreational species. LPC has conducted some exploratory and test fishing work. The authors know of no LPC work on oceanic pelagics such as swordfish, other billfish, and tunas. The LPC in the early 1990s has done some work, however, on dorado (dolphin fish).[464] Some work was also reported on dorado. One study collected commercial landing records and sampled gonads from sport fishing tournaments.[465] LPC coordinates some of its activities with the Division of Fish and Wildlife in the USVI.[466] LPC collects and analyzes the data from the domestic Puerto Rican fishery. Swordfish only appears occasionally in the data. LPC does not work with the landings data of the mainland longliners. The LPC has no current projects specifically addressing swordfish or other pelagics.[467]

National Marine Fisheries Service: The National Marine Fisheries Service (NMFS) is the U.S. Federal marine fisheries agency. It is part of NOAA in the Department of Commerce.[468] NMFS is responsible for both marine fisheries management and research. The agency has conducted longline surveys of oceanic pelagics on the south west coasts of Puerto Rico and the USVI.[469] The research vessel *Carite* conducted exploratory tuna fishing in 1963-65. Very poor results with long lines were achieved in the relatively shallow Mona Channel between Puerto Rico and the Dominican Republic. Better results with troll gear were reported for blackfin, skipjack, and small yellowfin. Longline sets north of San Juan and east to the Virgin Islands took some albacore and yellowfin. Yields totaled about 1 fish per 100 hooks. Other resource assessment work using *Crawford, Elmer*, and *Oregon* work around Puerto Rico resulted in about 0.4 fish per 100 hooks.[470] NMFS used S.K. funds in the early 1980s to fund some experimental demersal longlining off Puerto Rico.[471] The NOAA research vessel *Oregon II* was deployed off Puerto Rico during 1982-83 for test fishing using pelagic longlines and to place some fish aggregating devices (FADs).[472] NMFS has also done some work with demersal longlines off Puerto Rico.[473]

Old Dominion University: Old Dominion University in Norfolk, Virginia has done some work with pelagic FADs to attract fish in both recreational and commercial fisheries.[474] Most of the FADs deployed in a 1986 study off Cúlebra on Puerto Rico's eastern coast failed. Researchers believe that one of the causes was shark bites.[475]

Sea Grant: The U.S. Sea Grant Program is also part of NOAA. The UPR added a Sea Grant marine advisory service to its marine affairs program in 1977. The program was extended to include education and research in 1980.[476] A 1989 Sea Grant project accessed the marine recreational fishing industry in Puerto Rico and the Virgin Islands.[477] None of the other projects, however, currently focus on swordfish, other oceanic pelagics, or longlining. Projects include work on marine sanctuaries, seagrass, corals, pollution, sunami hazards, ciguatera, and other topics.[478] Sea Grant has also done some work with recreational fisheries.[479] Sea Grant officials report that there has been no recent work on oceanic pelagics and none is planned for the near future.[480]

Southeast Area Marine Assessment Program: The Southeast Area Marine Assessment Program (SEAMAP) is a joint cooperative program (Puerto Rico, USVI, NMFS, and Sea Grant) designed to generate fisheries independent data on area resources.

Universidad de Puerto Rico: The Universidad de Puerto Rico's (UPR) Departamento de Ciencias

***Photo 34.**--Researchers Roy Armstrong and Fernando Giles at the University of Puerto Rico Mayagüez Campus-BIOL are using remote sensing data to understand oceanographic processes and fish behavior.*

Marinas (DCM) is located at the Mayagüez campus. DCM/UPR researchers have played an important role in marine affairs research throughout the Caribbean. Research activities have included fisheries, aquaculture, seafood science, resource economics and management, as well as other non-fishery marine sciences. UPR understandably focuses primarily on Puerto Rico, but there is a strong interest in the USVI and other Caribbean islands--although funding for such activities have been very limited in recent years.[481] UPR researchers deployed a pelagic longline and reported some catches off the island's southwestern coast. DCM/UPR researchers participated in the 1982-83 longlining trials utilizing the NOAA research vessel *Oregon II*. The *Oregon II* researchers took some swordfish off the USVI (St. Croix) and Puerto Rico. These results confirmed the presence of swordfish in Puerto Rican and USVI waters.[482] Following up on the exploratory work, U.S. swordfish longline fishermen in 1984 initiated commercial operations. (See: "VI. Fleet Operations.") UPR researchers in 2000 published a report on dorado.[483] UPR are interested in pursuing a variety of projects concerning pelagic fisheries. One UPR researcher wants to compare the distribution of pelagic fish with chlorophyll fronts derived from satellite images. The shortage of funds has prevented this work, but the researcher in 2001 reports that funds may be available from the CFMC to work on dorado. The same researcher also hopes to do some oceanographic work on current flows around Puerto Rico.[484] Another researcher has compiled an extensive data base from larvae tows off southwestern Puerto Rico out to about 40 kilometers. He has noted a lot of scombroid larvae, but has not yet been able to classify them by species because of limited funding.[485]

University of Rhode Island: The URI is working in Puerto Rico through the Sea Grant program, but the project does not include swordfish or other oceanic pelagics.

Photo 35.--Data on the bycatch of the U.S. mainland longliners operating from Puerto Rico provide some bench-mark data on potential bycatch rates experienced in other Caribbean longline fisheries. Julio Serano

XV. Bycatch

Detailed data on the catch and landings as well as onboard observer coverage from U.S. longliners operating in the wider-Caribbean provide valuable information on bycatch rates. The U.S. data also provides bench-mark data to assess other Caribbean fisheries for which data is unavailable.[486] Caution is needed in using this data. While the U.S. data provides some insight, it can not simply be used as a substitute for local data. The U.S. Caribbean longline fishery relies more heavily on swordfish than the smaller-scale longline fishermen on the various islands which often use a greater share of the non-swordfish catch. In some cases what U.S. fishermen classify as bycatch is actually targeted by Caribbean fishermen. Along with factors such as gear, methods, seasonality, grounds and other variables, the U.S. results may vary substantially from those of longline fishermen on the different Caribbean islands. Despite these limitations, the U.S. data is useful, however, in providing an indication of possible bycatch levels. These results from U.S. longlining are especially important because published catch data, let alone bycatch data, is unavailable from many Caribbean island fisheries.

Catches: U.S. fishermen operating in the Caribbean during 1993 reported that nearly half of their catch was swordfish and of those fish, most were retained (appendix G1a). Caribbean fishermen reported in 1993 that 49.5 percent of their catch was swordfish (figure 24). In all the other U.S. Atlantic longline swordfish fisheries, except the southeastern fishery, swordfish constituted less than 30 percent of the catch. A very high percentage of the Caribbean catch were adult fish that could be retained. Caribbean fishermen retained 86 percent of the swordfish caught. Except for the Grand Banks fishery, other Atlantic-coast longliners retained less than half of their catch (Caribbean Overview, appendix D8b).[487]

Landings: In terms of actual landings, swordfish accounted for an even larger share. The great bulk of Caribbean operations, well over 80 percent in both 1998 and 1999 (appendix G1b2a). Some species can not be landed (billfish and turtles). Other species are not landed because there is no market for them or prices are quite low (lancet fish and various sharks). This means that the quantity of bycatch species being landed by the U.S. mainland fishermen, other than tuna, is very limited. This is not always the case as regards the longline fishermen on different Caribbean islands.

Major species taken by the U.S. longliners, other than swordfish, in number of fish include: dorado, sharks (mako, thresher, oceanic white tips, and others), lancetfish, snake mackerels (oil fish), tunas (yellowfin, bigeye, and bluefin), billfish, wahoo, and others (appendix G1b1). Some turtles (mostly hawksbills) are also taken. While swordfish is generally the target species, some of these species have substantial market value. Others such as billfish and turtles are of concern to environmentalists and needed efforts to reduce the catch of these species, such as area closures, is adversely affecting the fishery.

U.S. market: The swordfish, bluefin, and large yellowfin taken by the commercial longliners are shipped to the mainland United States, mostly Boston.

Puerto Rican market: Most of the other bycatch species retained are marketed in Puerto Rico. The mako and thresher sharks are retained and marketed. The very small swordfish by-catch reported by artisanal fishermen was marketed in Puerto Rico, but since 1999 the artisanal exemption was dropped and none of the fishermen applied for swordfish permits. Some of the swordfish catch of the mainland longline fishermen is marketed in Puerto Rico. Puerto Rican officials, however, believe that some of the swordfish sold locally is purchased in the mainland United States.[488]

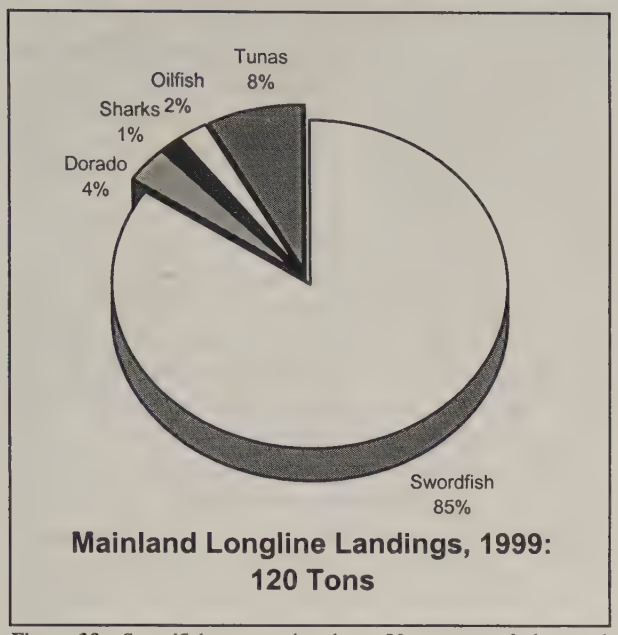

Figure 38.--Swordfish was only about 50 percent of the catch (individuals), but the species was over 80 percent of landings (quantity). Some of the bycatch is discarded and swordfish are very large fish.

At sea discards: U.S. fishermen must discard certain bycatch species at sea. In the case of sharks, here are prohibitions on finning and discarding carcasses. Regulations on the handling of the bycatch has become increasingly strict in recent years.

Billfish: Federal regulations require the commercial (including the artisanal) billfish bycatch to be discarded.[489] The exemption for artisanal fishermen in Puerto Rico was ended in 1999. Researchers are very concerned about the status of billfish stocks.[490]

Sharks: There has been increasing concern in recent years about shark populations. U.S fishermen longlining for swordfish must also have shark permits. Most of the sharks (except makos and threshers) until 1993 were finned and discarded. Finning was prohibited in Federal waters during 1993. Some finning continued in state waters unless prohibited by state law. Finning was, however, never a significant problem in Puerto Rican waters. Local fishermen did not significantly target sharks.[491] There were no specific Puerto Rican regulations prohibited finning, but new Federal regulations were issued in 2001. President Clinton signed a law in December 2000 prohibiting shark finning on all U.S.-flag fishing boats, regardless of where they were fishing.[492]

Turtles: Environmentalists are especially concerned about sea turtle populations. Turtles must also be discarded.[493] Detailed Federal regulations govern the handling of turtles.[494] The turtles taken incidentally are primarily loggerheads and a smaller number of leatherbacks (Caribbean Overview, appendix G1b1). Most are brought on board live.[495] A biological opinion obtained on the handling of turtles raised concern about the survival rate of the turtles brought aboard. NMFS in 2001 is in the process of addressing this problems with new fishing regulations establishing procedures for the safe handling of turtles.[496]

Area closures: NMFS published regulations establishing area closures to reduce bycatches in the Gulf of Mexico and the Atlantic off the southeastern states. NMFS also established another closed area off the northeastern coast to reduce the serious injury and mortality of threatened and endangered sea turtles taken in the fishery.[497]

A. Tuna

Tuna is taken by both the U.S. longliners operating from Puerto Rico and local fishermen employing handgear from small boats. The two different groups of fishermen experience varying results due to differences in gear and fishing grounds. While the local fishermen involved in the fishery for oceanic pelagics often target tunas, it is a bycatch species for the mainland longliners--although of some commercial importance. The U.S. longliners were reporting substantial catches, but the small number of longliners by 1999 only account for a relatively small catch (appendix G1b2b). Puerto Rican fishermen in contrast have been increasing catches (appendix D2d). Dealers confirm that the tuna landings of the local artisanal fishermen have been rising.[498]

U.S. Longliners: Tuna is the principal bycatch species landed by the U.S. mainland longline fishermen operating from San Juan. While a bycatch species, the

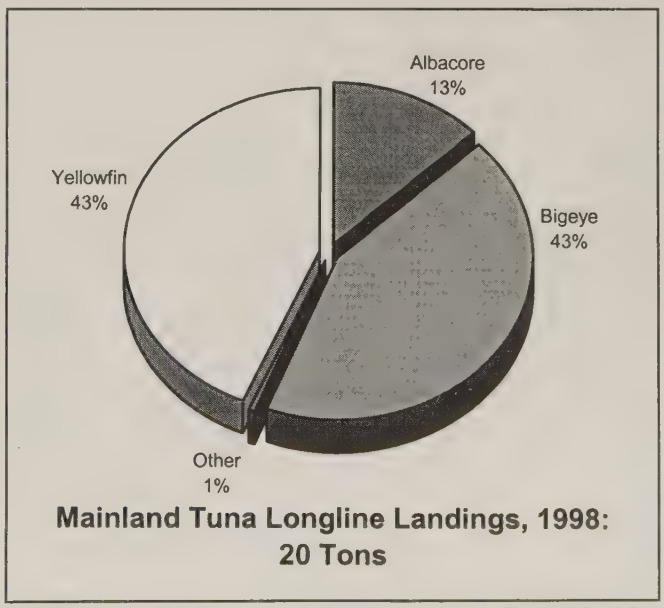

Figure 39.--Tuna landings in 1998 totaled over 20 tons. The mainland fleet reported substantial landings of mostly bigeye and yellowfin.

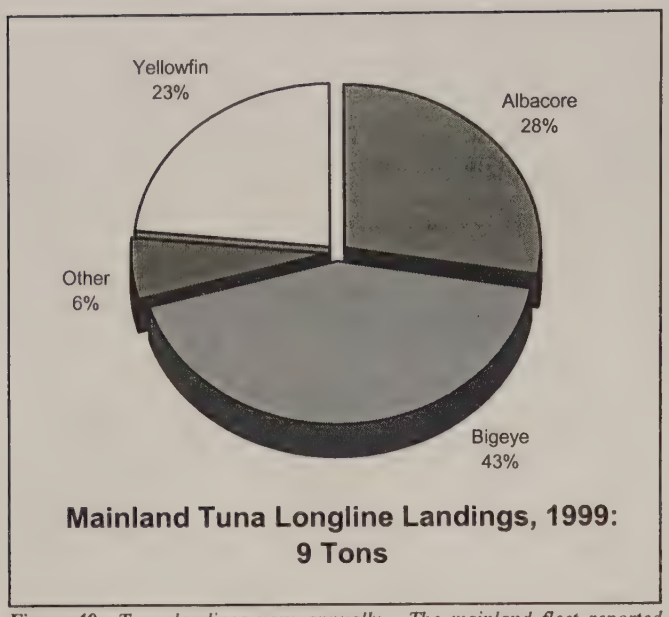

Figure 40.--Tuna landings vary annually. The mainland fleet reported substantial landings of albacore, bigeye and yellowfin in 1999.

tuna landings often make an important contribution to a vessel's operations, especially in recent years as the prices compared to swordfish have risen on the U.S. market . Logbook and observer data indicates that tuna accounts for about 8 percent of the U.S. Caribbean longline landings in number of individuals and 8-10 percent of landings in quantity (appendices G1b1 and G1b2b). U.S. landings consist primarily of bigeye, yellowfin, and albacore as well as smaller numbers of other species. Most of the albacore and yellowfin is retained, although more of the bigeye is discarded because of the small size (appendix G1b1). The composition of landings can vary substantially from year to year. Mostly bigeye and yellowfin were landed in 1998 while the catch was more evenly divided among albacore, bigeye, and yellowfin in 1999--but much smaller quantities were landed (appendix G1b2b).

Domestic fishermen: The local Puerto Rican tuna catch is primarily taken with handlines and troll gear. The boats include both recreational charter boats and small boats used by the artisanal fishermen (appendix A5). A few fishermen also have harpoon permits. The authors have no data on actual catches by the different types of fishermen, but they account for most of Puerto Rico's overall tuna catch. The Puerto Rican domestic tuna catch has been highly variable over time (appendices D2b series). The authors can not at this time explain the fluctuations. A record catch of 115 t was reported in 1981. The artisanal (commercial) catch in the early 1990s was quite low, only about 10-30 t (appendix D2d). The catch peaked at 90 t in 1997. It has since declined to only 60 t in 2000, but that is still twice the level reported in the early 1990s. It is also higher than reported by the mainland longliners since the fishermen shifted effort back to the mainland.

B. Billfish

Billfish was also taken by both the U.S. longline fishermen and the local artisanal fishermen. The two groups, however, viewed it differently.

U.S. longliners: Billfish has been seen as a bycatch by the U.S. longline fishermen. After U.S. regulations prohibited Atlantic billfish catches, U.S. fishermen have tried to reduce the billfish bycatch. Billfish bycatches by the commercial fishermen has been an issue often raised by recreational anglers. The U.S. fishermen can not sell Atlantic billfish and catching billfish reduces the catch of marketable species. The commercial fishermen are thus interested in reducing the bycatch as much as possible. Observers report that billfish in 1993 constituted over 5 percent of the U.S. Caribbean swordfish catch in terms of individuals. The catch was relatively equally distributed among the marlin species (white marlin, blue marlin, and to a lesser extent sailfish). There was also a substantial number of spearfish (appendix G1b). All of the billfish is discarded because of U.S. Federal regulations prohibiting the take of Atlantic sailfish.

Domestic fishermen: Artisanal fishermen for years viewed marlin as a fortuitous and valuable catch. Much less data exists, however, on the domestic bycatch. A

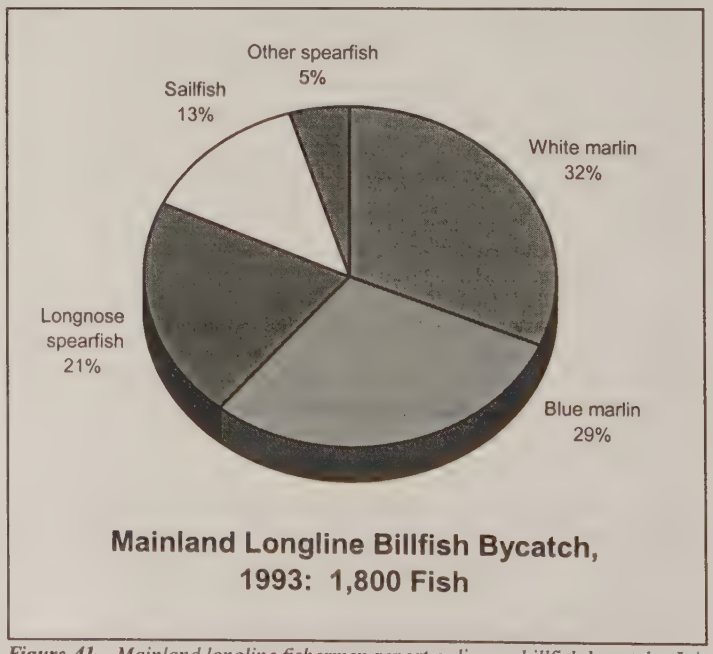

Figure 41.--Mainland longline fishermen report a diverse billfish bycatch. It is likely that the artisanal fishermen also take several species as bycatch.

record catch of over 15 t was reported in 1981 (appendix D2b2b). Even after commercial Atlantic billfish catches were prohibited for U.S. fishermen, an exemption was made for small-scale Puerto Rican fishermen. That exception has since been closed. The only billfish reported in Puerto Rican statistics was blue marlin. This could mean that the local fishermen were only taking blue marlin, but this seems unlikely given the diverse billfish bycatch reported by the mainland longliners (appendix G1b). In addition, the behavior of billfish suggests that it is unlikely that the artisanal fishermen would only catch blue marlin. White marlin, for example, are more of a coastal species than blue marlin. The appearance of only blue marlin in available statistics may mean that many fishermen were using blue marlin as a general description for all billfish. A Puerto Rican researcher involved with collecting statistical data reports that billfish catches are not common. On the rare occasions that he has seen them landed, they have always been blue marlin.[499] We do not know if other species were being discarded. The last artisanal catch was reported in 1994 (appendix D2d). Puerto Rican artisanal fishermen are critical of Federal regulations which since 1999 have removed the artisanal exemption and now prohibit both the artisanal and commercial catch of marlin and other billfish. These species are reserved for recreational fishermen. Artisanal fishermen occasionally report seeing some recreational fishermen illegally selling billfish and are upset that they are unable to do the same.[500]

Recreational fishermen: Sport fishermen in Puerto Rico target billfish. Given the size of the recreational fleet and the interest in sport fishing, the billfish catch is substantial. A NMFS enforcement agent reports that the sports tournaments held in the second half of the year are one of the main contributors to the heavy exploitation of the species.[501] Sport fishermen report that billfish over 300 pounds (136 kg) are rarely caught while 10-15 years ago they were common.[502]

C. Shark

Sharks are taken both by Puerto Rican artisanal fishermen and U.S. longline fishermen. Few details are available on the species taken by the artisanal fishermen, but species composition is available on the shark bycatch reported by the mainland longline fishermen. Blue and silky shark are the primary species reported, but makos and a few other shark caught in smaller numbers are the principal species retained.

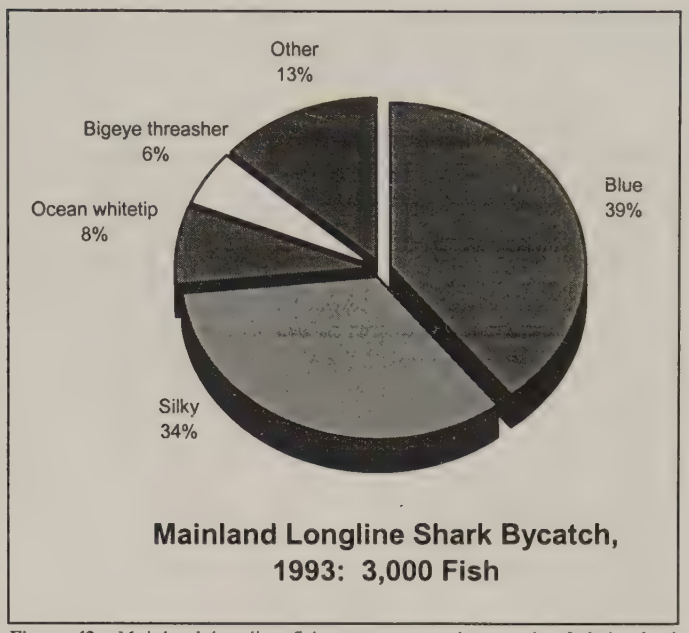

Figure 42.--Mainland longline fishermen report that much of their shark bycatch was blue and silky shark, virtually all of which is discarded.

U.S. longline fishermen: Logbook data compiled in 1993 suggests that sharks constitute about 9 percent of the U.S. Caribbean longline catch, in terms of individuals (appendix G1b). Most of the sharks were either blue or silky sharks. The blue sharks are discarded and only a few of the silky sharks are retained. Several other species were taken in small quantities, but discarded (appendix G1b). The relative importance of sharks and the species composition

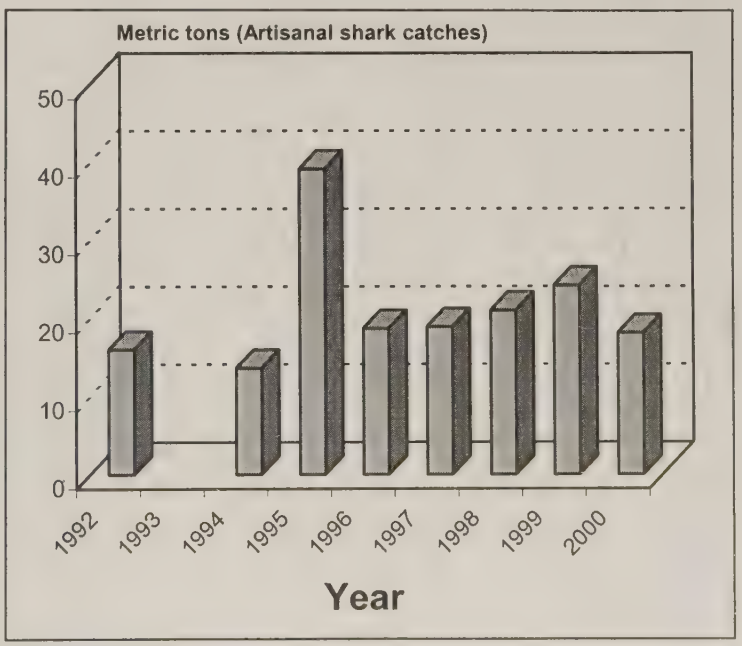

Figure 43.--Shark catch data shows no clear trend. Anecdotal reports, however, suggest that shark populations are being depleted off Puerto Rico

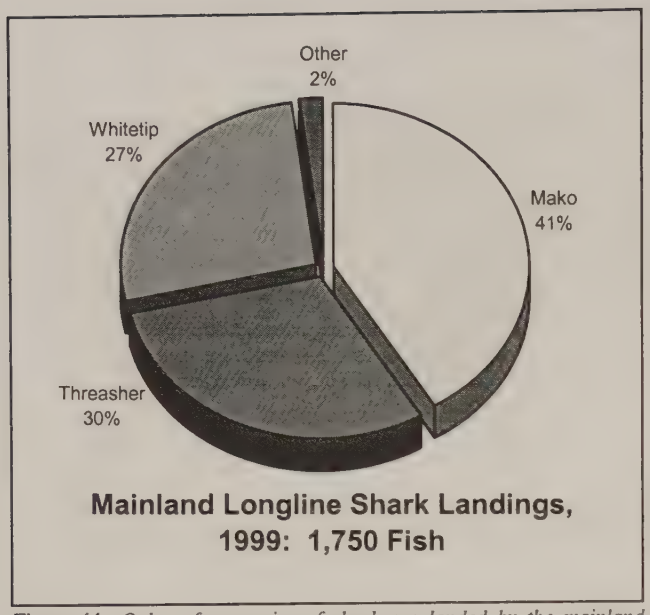

Figure 44.--Only a few species of shark are landed by the mainland longline fishermen, generally makos, threshers, and whitetips.

varies from year to year so an assessment of multiple years is needed for a better picture of the shark bycatch. While the number of blue sharks accounted for about 40 percent of the total shark bycatch, the numbers were only a fraction of those reported on more northerly grounds. Most of the individuals retained and landed were threshers, makos, whitetips (appendix G1b2b). The NMFS Southeastern Fisheries Science Center (F/SEC) has analyzed the weight of the sharks found in the bycatch.[503]

Domestic fishermen: Domestic fishermen have never shown great interest in shark. They do, however, take small numbers of sharks. The first reporting occurred in 1984. Relatively small quantities were reported until 1998 when a catch of 13 t was noted (appendix D2b2b). The record catch was nearly 40 t in 1995 (appendix D2d). Fishermen reported a catch of only 18 t in 2000. The authors have noted very little information about Puerto Rican shark fishing. An elderly Cuban fishermen was active on Cúlebra islands for several years, targeting nurse sharks.[504] An Arecibo fishermen currently reports a small directed shark fishery. For the most part, however, sharks are taken incidentally in Puerto Rico by several gear. About half the catch is reportedly taken by bottomlines (appendices D2e1-2). No species composition data is available on the domestic catch. Some idea of the species present can be obtained through the mainland longlined bycatch, but differences in gear, grounds, seasons, and other factors mean that there will be substantial differences. Data shows notable variations in the shark catch during the 1990s with no clear trend. Nearly 40 t was caught in 1995, but that appears to have been an unusual year. The catch has normally been from about 14-24 tons. The 2000 catch totaled 18 t (appendix D2d). Data compiled by the LPC shows somewhat different catch levels, but also no discernable trend (appendix D2c).

Some observers are concerned about the status of shark populations off Puerto Rico. The lack of clear trends in the available data provide few clues. Commonwealth officials are concerned as a result of a variety of anecdotal reports that sharks may be becoming scarce in Puerto Rican waters. They are apparently much less abundant now than was the case in the 1980s.[505] Officials are not sure what has depleted the shark populations. Puerto Rican fishermen have not targeted sharks to any great extent. There is, however, extensive recreational diving off Puerto Rico. Divers often carry power heads for security and may use them in many non-threatening situations. There is also extensive commercial longlining in offshore waters and substantial quantities of shark are taken in the bycatch. The dynamics of the shark population off Puerto Rico, however, is not well understood.

D. Other finfish

Several other finfish are reported by observers in the U.S. Caribbean longline catch. The most important in economic terms is dorado.

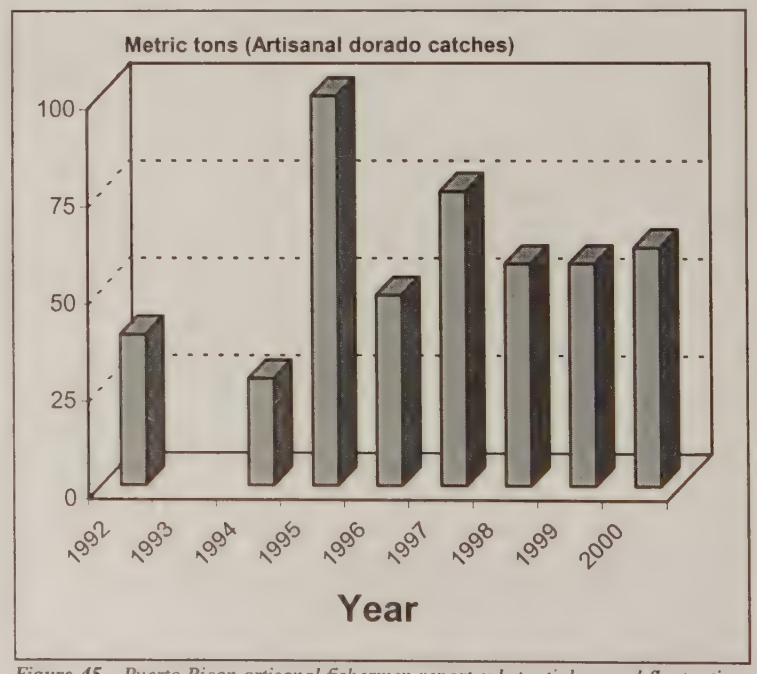

Figure 45.--Puerto Rican artisanal fishermen report substantial annual fluctuations in the dorado fishery. Catches in recent years have been relatively steady.

Dorado: Dorado or dolphinfish (*Coryphaena hippurus* Linnaeus), is a migratory pelagic fish distributed throughout the tropical and subtropical waters of the world.[506] They are fast swimming, migratory, pelagic fish, which support commercial and sport fisheries throughout the western central Atlantic. The seasonality pattern of dorado catches in the eastern Caribbean have led some fishermen to speculate that there are at least two distinct stocks, a "northern" and a "southern" stock.[507] (See the Barbados chapter for a summary of their findings.) This hypothesis was based upon life history characteristics and on observed differences in allelic frequencies of IDH-2,3. U.S. researchers tested Oxenford and Hunte's hypothesis and investigated the possible presence of additional stocks in the Gulf of Mexico and western central Atlantic using RFLP analysis of the ND-1 region of the mtDNA. Dorado DNA samples were collected from the Carolinas, Georgia, Florida, the Gulf of Mexico, Puerto Rico, Bermuda, the Azores, Martinique, Barbados, Tobago, Brazil, and the Pacific off Costa Rica. The ND-1 region of each specimen was amplified by PCR and digested with five different restriction endonucleases. The results from the analysis of the frequency distribution of composite mtdna haplotypes and AMOVA found significant differences between Costa Rica and the western central Atlantic. These analyses failed to reject the null hypothesis that dorado in the western central Atlantic comprise a single unit stock.[508] Preliminary studies suggest that two different populations of dorado frequent the Caribbean and western Atlantic throughout the year.[509] Dorado is one of the few oceanic pelagic species that Puerto Rican researchers have addressed.[510]

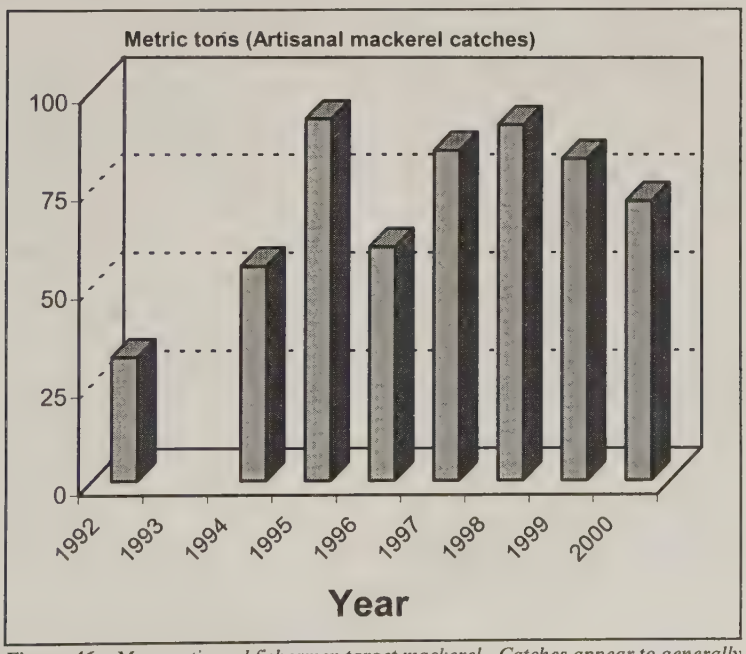

Figure 46.--Many artisanal fishermen target mackerel. Catches appear to generally rise and fall in tandem with the dorado fishery.

U.S. Longline fishery: Dorado is the bycatch species taken in the largest numbers. Some dorado are taken as a bycatch by U.S. longline fishermen. They constitute over 11 percent of the catch in terms of numbers. A very high percentage of the fish are retained, over 80 percent (appendix G1b). Given the smaller size of dorado, they would constitute a much smaller portion of the catch if calculated in quantity.

Recreational fishery: Dorado are also taken as a bycatch in the islands many billfish tournaments, but there are also some specialized dorado tournaments.

Domestic artisanal fishery: Dorado is a valuable part of the pelagic fishery on several Caribbean islands including Puerto Rico. Catches have varied substantially over time. Catches in some years have been very low, only 7 t in 1984 (appendix D2b2a). Puerto Rican fishermen in recent years have reported larger catches, posting a record catch of over 100 t in 1995 (appendix D2d). The 2000 catch was over 60 tons. Catches are seasonal with the best caches reported from November to May.[511]

Snake mackerels: Snake mackerels include several different species often reported in the longline fishery, including oilfish. U.S. mainland longline fishermen take substantial quantities of these species. The catch in 1993 was over 7 percent (appendix G1b). The only species generally landed, however, has been oilfish (appendix G1b2b). The species, because of their oceanic habitat, are not normally taken by Puerto Rican artisanal fishermen (appendix D2 series).

Lancetfish: The U.S. mainland longline fishermen report that catches of lancetfish fish can be substantial. Fishermen in 1993 reported nearly 8 percent of the catch was lancetfish (appendix G1b). The various species of lancet fish have a wide occupance and are commonly reported in the tuna-swordfish longline bycatch.[512] This small slender species has no commercial value and is discarded. This is a considerable cost to the fishermen, because it means that all of the hooks which lancetfish take are not then not available for swordfish and tunas. The authors know of no lancetfish catches by the domestic artisanal fishermen.

Mackerel: Mackerel are not generally taken by the commercial longliners (appendix G1b). They are, however, in many years is the principal pelagic species taken by domestic Puerto Rican fishermen. The record catch of 170 t was reported in 1981 (appendix D2b2b). Catches in the 1990s have been generally lower, but exceeded 90 t in 1995 and 1998 (appendix D2d). Catch trends are somewhat similar to dorado.

D. Turtles

Several species of sea turtles forage and or nest on Puerto Rico and offshore islands. The most common species off Puerto Rico are leatherbacks, hawksbills, and greens. Loggerheads are occasionally seen, but olive Ridleys are rarely reported.

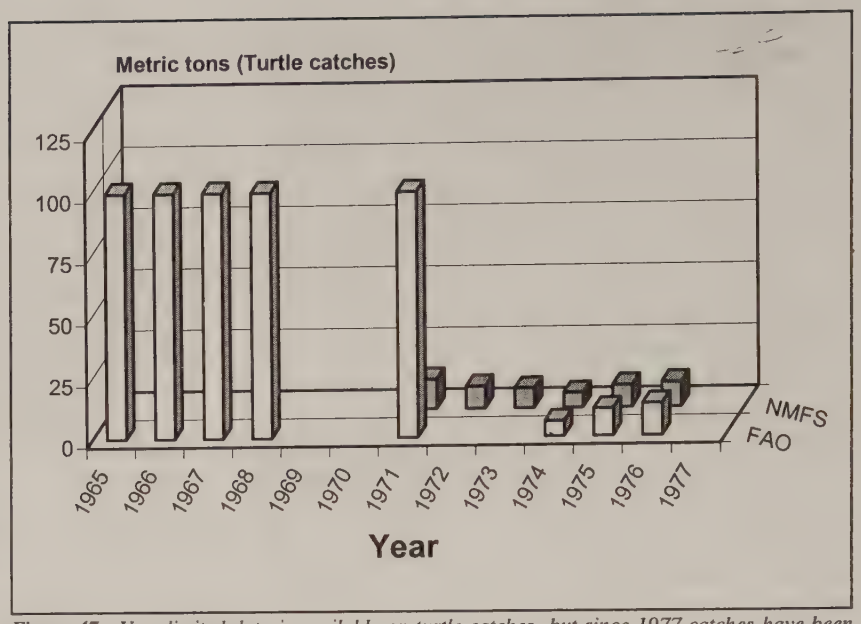

Figure 47.--Very limited data is available on turtle catches, but since 1977 catches have been limited to minor illegal poaching.

Leatherbacks: Leatherbacks are found off Puerto Rico and the U.S. Virgin Islands during the nesting season. An important nesting site for leatherbacks is the Sandy Point National Wildlife Refuge on St. Croix in the U.S. Virgin Islands.[513] There is also nesting on Puerto Rican beaches. One researcher reports that Brava and Resaca on Cúlebra are the most important leatherback nesting beaches (by nesting density) in the U.S. Caribbean territories.[514] Leatherbacks require open sand beaches with no near shore reef. Such conditions are available on Cúlebra Island and along Puerto Rico's northern coast.[515] A minor nesting cite on Cúlebra is notable because researchers believe that they are able to tag all nesting females and nesting events.[516]

Greens: Green turtles forage throughout the coastal waters of Puerto Rico and the Virgin Islands. There is some nesting on St. Croix. One source reports that there are no known nest sites on Puerto Rico.[517] At least one Puerto Rican researcher, however, reports that there is an active nesting rookery for green turtles along the eastern side of Vieques at the Navy's live fire range.[518] The species is abundant in the waters off Puerto Rico. One study showed a high abundance around Cúlebra Island off Mosquito Bay and nearby Culebrita.[519]

Hawksbills: Hawksbills (*Eretmochelys imbricata*) both nest and forage off Puerto Rico. Hawksbills are solitary nesters. The primary nesting beach is on Mona Island off the island's western coast.[520] Hawksbills off Mona and Monita Island have been used to test tags.[521] Preliminary genetic analysis indicates that hawksbills foraging off Puerto Rico primarily nest at the U.S. Virgin Island (St. Croix), but nesters have been noted through genetic studies from beaches throughout the northeastern and northwestern Caribbean (including Mexico, Belize, Cuba, Puerto Rico--Mona Island, the U.S. Virgin Islands, and Antigua), but not Barbadian and Brazilian beaches to the south. While the contribution from the Virgin Islands were particularly high, the small

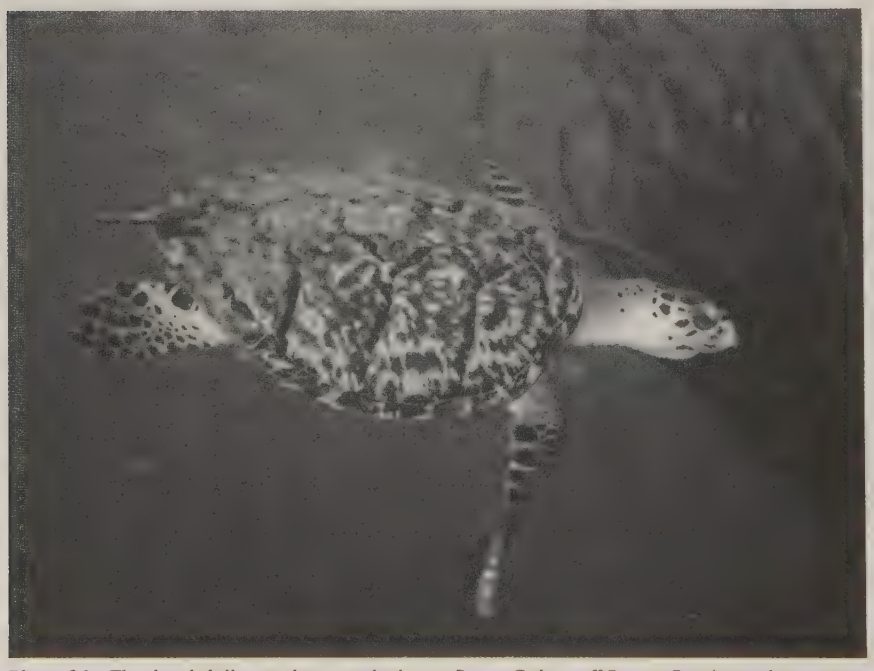

Photo 36.--This hawksbill was photographed near Punta Galera off Puerto Rico's southwest coast. The presence of sea turtles is an attraction to divers and thus an important tourist attraction. Lamarr Trott

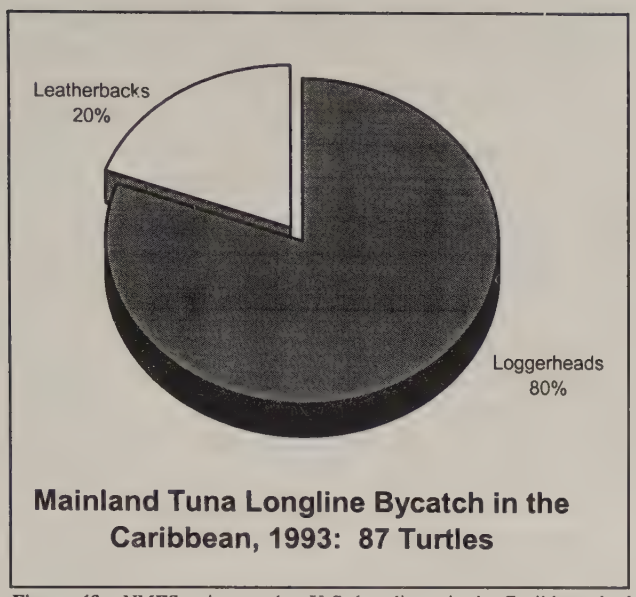

Figure 48.--NMFS estimates that U.S. longliners in the Caribbean had 87 turtles interactions during 1993. Interactions have declined in the late 1990s because of reduced effort.

number of samples do not yet provide the basis for any statistically valid conclusions.[522]

Loggerheads: Loggerheads off Puerto Rico are reportedly transitory and only occasionally seen.[523] This may be because observations are primarily based on sightings along the beach or from inshore waters. Loggerheads may be more common in offshore waters.

Olive Ridleys: This species is almost never seen off Puerto Rico. There is only one confirmed sighting.[524] A Puerto Rican researcher reports finding a stranded olive Ridley off Puerto Rico which he helped rehabilitate and release.[525]

Sea turtles have been taken in Puerto Rico for centuries. The fishery in the 19th century was small-scale subsistence fishing.[526] Puerto Rican fishermen took turtles with reef-fish gillnets, spears, and by diving.[527] The turtles were generally butchered and sold to local villagers on the beach. The south and west coasts were where most of the turtles were caught. Leatherback eggs were collected.

The fishery was reportedly expanding when it was in effect prohibited by the passage of the *Endangered Species Act* in 1973.[528] Some disagreement exist as to the precise level of turtle catches. Very limited catch data is available. FAO reports that the catch was about 100 t in the late 1960s and early 1970s (appendix G2a). This is a rounded figure which means that it could represent as little as 50 tons. A NMFS report based on Puerto Rican sources indicates catches of 6-12 t during the 1970s (appendix G2a). No information is available on the species make up of the harvests, but they are believed to have been primarily hawksbills and greens along with some leatherbacks. Greens (for the meat and oil) and hawksbills (for the shells) were the most prized. Other species are not common off Puerto Rico or in the case of loggerheads, primarily occurring in offshore waters beyond the range of the island's small artisanal fleet. Although taking turtles is now prohibited on Puerto Rico, some poaching continues to occur. U.S. Fish and Wildlife Service officials, for example, report that 12 persons were arrested in 1994 for selling turtle eggs to local restaurants.[529]

As is the case with turtles throughout the Caribbean, a wide variety of threats endanger sea turtles off Puerto Rico. The gravest danger is harvesting nesters, but since the 1970s this threat has been substantially reduced. The loss of habitat due to coastal development is a major concern. The major nesting site on Mona Island is protected, but even here damage from foraging animals can be devastating. On Mona Island, feral hogs destroyed large numbers of nests in the 1980s.[530] Other threats include upland development, boating, ingestion of marine debris, entanglement in discarded fishing gear, and insufficient enforcement. The varying protection programs of other Caribbean countries is another concern.[531]

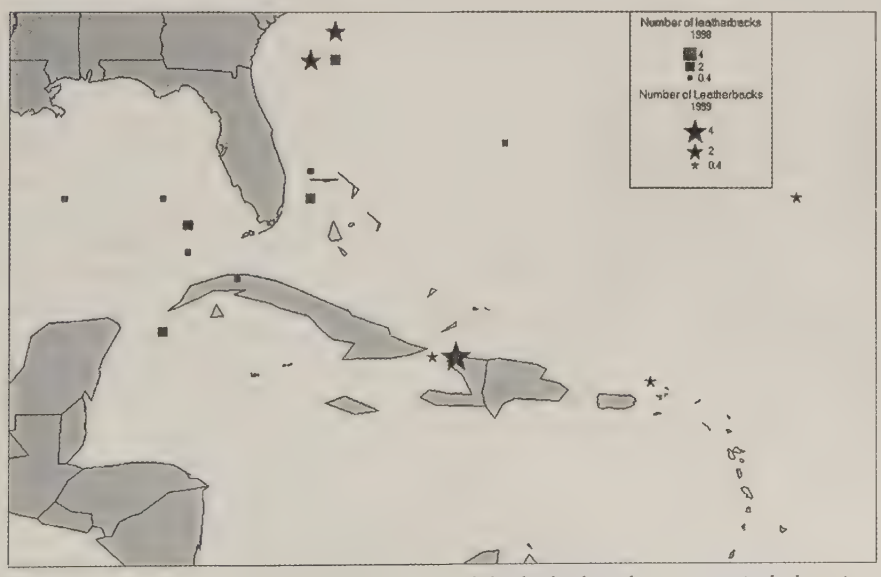

Photo 37.--U.S. Caribbean longline interactions with leatherback turtles were particularly serious in the Windward Passage, in part because considerable fishing effort is concentrated there

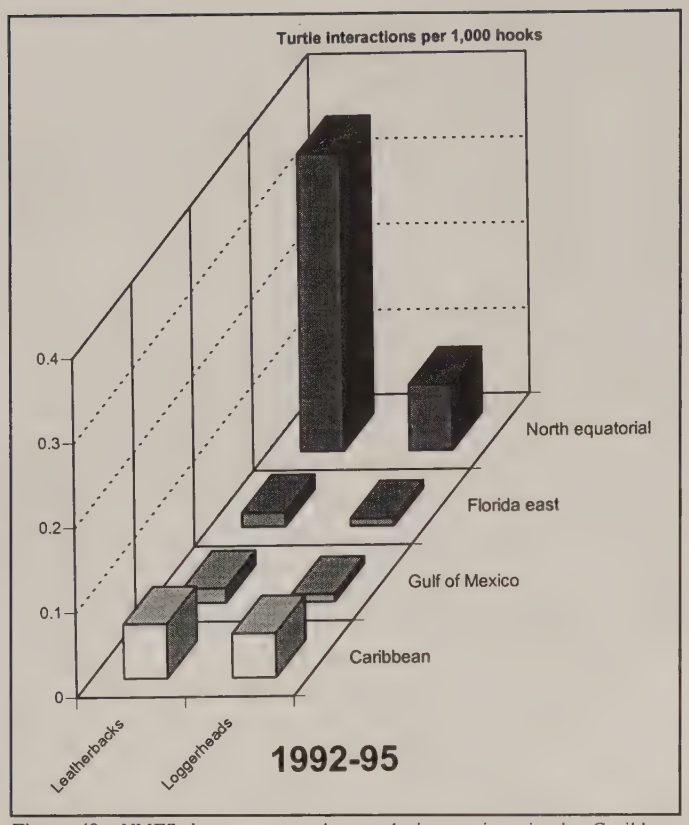

Figure 49.--NMFS data suggests that turtle interactions in the Caribbean exceed those along the U.S. southeastern coast, but are lower than in the Atlantic east of the Caribbean.

Turtle researchers on Puerto Rico report that efforts to protect the nesting beaches are paying off. One researcher reports that by 1987 that nesting activity along the northern coast had declined to only 12 nests at one beach. As of July, 360 nests have been reported at that beach in 2001.[532]

The situation at sea is less clear. A serious, but difficult to quantify problem is fishery interactions with turtles at sea. There are interactions both inshore and offshore. Increasing attention is being give to interactions with longlines, but interactions with artisanal fishermen are also a concern.

Artisanal fishing: Some inshore artisanal fishing methods are hazardous to sea turtles. Trap fishing is still one of the principal fishing methods. While adults and older juveniles are generally not impacted, smaller juveniles can enter traps and be drowned. Gillnets ("trasmallos") have not been a major fishing methods, but as elsewhere in the Caribbean, the use of monofilament gillnets by Puerto Rican fishermen is increasing.[533] Local observers have mentioned increasing effort with gillnets in recent years to the authors.[534] This is of particular concern because gillnets are the single most hazardous artisanal gear for turtles. Artisanal fishermen can take turtles foraging in coastal waters as well as nesting turtles which remain in inshore waters between nesting. (Turtles come ashore several times to make nests and deposit eggs and thus concentrations of turtles can often be found just off the beaches during peak nesting events.)[535] NMFS enforcement agents in June 2001 reported arresting an artisanal fisherman for landing a turtle.[536]

Longline fishing: The turtles also face dangers from offshore pelagic longlining. NMFS has determined that the two species of sea turtles most affected by longlining are loggerheads and leatherbacks (Caribbean Overview, appendix G1b1). Loggerheads are often hooked when ingesting baits. Leatherbacks are more commonly ensnared in the lines. Some turtles may be attracted by light sticks, but there is some controversy about this. Available data does show higher hook rates when lightsticks are used (appendix G5f), but other factors could be involved such as variations in the set depths. Turtles that are hooked or ensnared can drown. They are also vulnerable to shark attack.

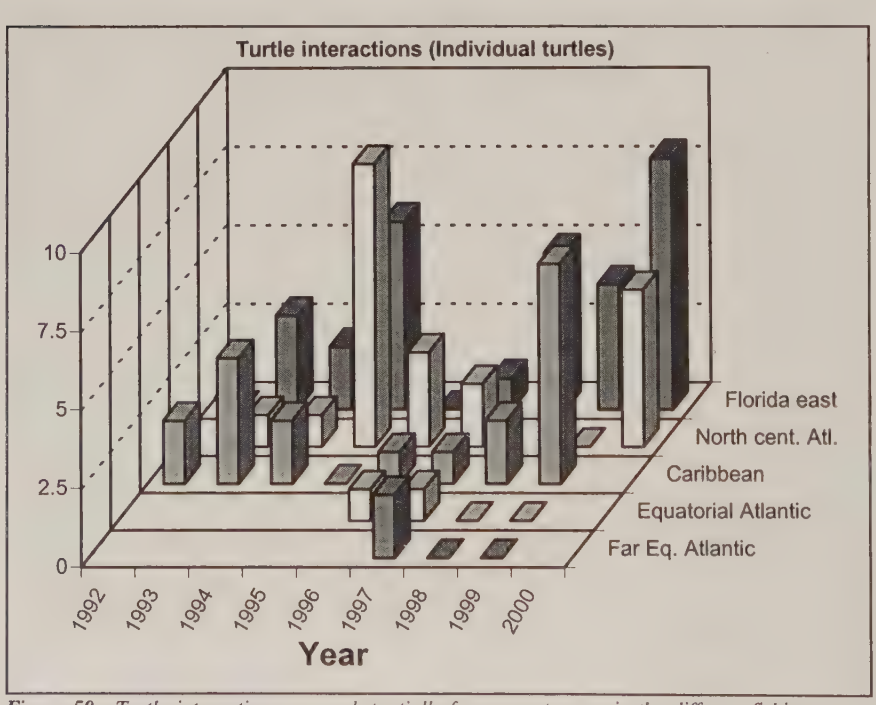

Figure 50.--Turtle interactions vary substantially from year to year in the different fishing areas. One important variable affecting the number of interactions is the level of effort.

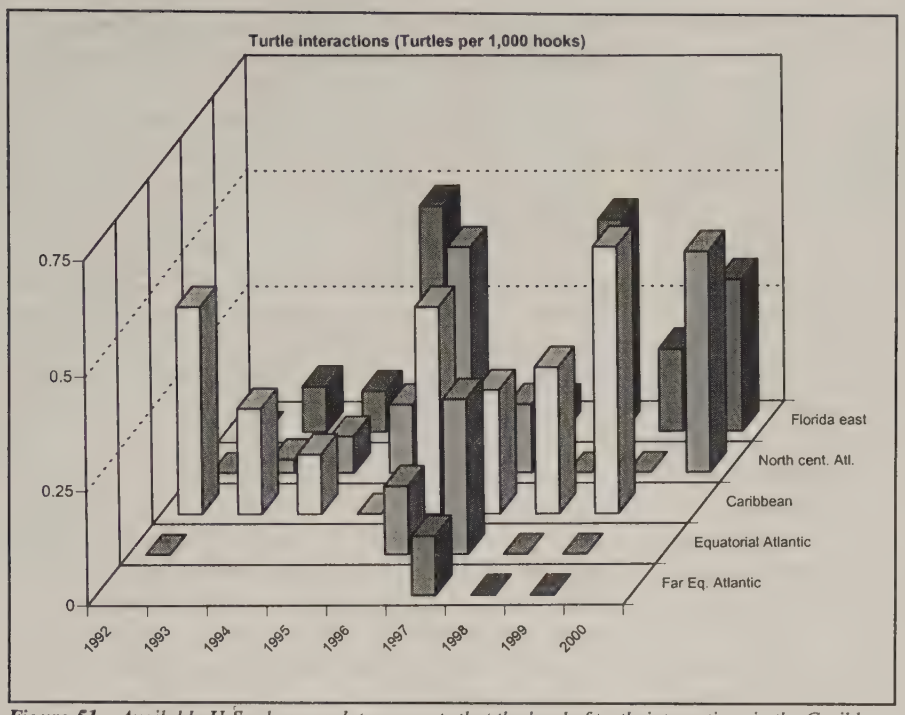

Figure 51.--Available U.S. observer data suggests that the level of turtle interactions in the Caribbean is higher than in surrounding areas.

been relatively limited.

Distant-water countries: In many areas, fishing effort by distant-water fishing countries far exceeds that of U.S. fishermen. No information is available on the turtle interactions of most other countries. The data from the U.S. fleet does show that turtles are taken in the Atlantic east of the Caribbean (appendix G2c2). This strongly suggests that the longline fishery conducted by Japan, Spain, Taiwan, and others may experience substantial turtle interactions.

Caribbean islands: The U.S. bycatch data suggests that interactions with turtles are particularly high in the Caribbean. Interactions ranged from 0.13 turtles per 1,000 hooks (1994) to 0.58 turtles per 1,000 hooks (1999) (appendix G2e2). It is unclear why the interactions are relatively high in the Caribbean, it may be that turtles are more concentrated there as they nest or forage around the islands. This is the area in which most of the island longline and artisanal fishermen operate and generally closer to the islands than the U.S. fishermen. Thus the turtle interaction rates and retentions of turtles is by Caribbean longline fishermen may be higher than that of the U.S. fleet.

Longline interactions have been studied in some depth by NMFS researchers and data exists from the U.S. pelagic longline fleet from both log books and observers. This data is of some importance because it is the only longline fishery in the wider-Caribbean for which detailed data exists on longline interactions. There appear to be relatively few turtle interactions close to Puerto Rico, but this may be a reflection of the limited effort there. NMFS data shows that substantial turtle interactions do occur in the wider-Caribbean. In 1993, for example, there were an estimated 87 turtle interactions in the Caribbean (Caribbean Overview, appendix G1b1).[537] All of the turtles were returned alive, although no data exists on actual survival rates. The level of interactions in the Caribbean appears to fall in the middle of the range comparing the Caribbean with other fishing areas (Caribbean Overview, appendix G5d-e). Interestingly the level of Caribbean interactions is higher than in the Gulf of Mexico and along the eastern Florida coast, but lower than further east out into the Atlantic for both leatherbacks and loggerheads (appendix G2b). Low levels of data, however, limit the validity of the Atlantic data east of the Caribbean. One matter of concern is that the available data for Caribbean operations is much higher than for U.S. operations around the Hawaiian Islands (Caribbean Overview, appendix G5g).

The interactions shown by U.S. data is of particular importance. The numbers may appear small, but U.S. effort in the Caribbean and adjacent areas has

If the levels of interactions experienced by U.S. fishermen are extrapolated by the sometimes substantial fishing effort of other countries (both Caribbean island and distantwater), the number of turtles involved reaches significant levels. Many of these turtles are either migrating from or to various Caribbean islands. It should be noted that the number of turtles nesting on some islands is now only a handful of animals, the potential impact of these interactions can be seen to be substantial.

Sea turtles have been involved in the controversy between the U.S. Navy and local groups over the use of Vieques island off Puerto Rico's eastern coast for live fire exercises. Local groups charge that sea turtle habitat is being affected.[538]

E. Marine mammals

A wide range of cetaceans have been reported off Puerto Rico. Humpbacks (*Megaptera novaeangliae*) from northwestern Atlantic feeding grounds have been observed off Puerto Rico and movements have been noted from islands to the south in the Lesser Antilles.[539] The Silver Bank north of the Dominican Republic appears to be a more important mating and calving ground than the Mona Passage or the Virgin and Anguilla Bank to the east of Puerto Rico.[540] Scientists have detected minkes (*Balaenoptera acutorostrata*), including mother calf pairs in the north Atlantic between Puerto Rico and Bermuda.[541] Melonhead whale (*Peponocephala electra*) are poorly documented in the Atlantic, but one record exists from Puerto Rico.[542] Puerto Rican researchers have conducted an extensive study of marine mammal strandings in waters off Puerto Rico as well as the U.S. and British Virgin Islands, using records going back to 1867. They found reports on 19 different cetaceans. The most commonly stranded species was the bottlenose dolphin (*Tursiops truncatus*). Other species reported in relatively large numbers included: Cuvier's beaked whale (*Ziphius cavirostris*), sperm whale (*Physeter macrocephalus*), Atlantic spotted dolphin (*Stenella frintalis*), and short finned pilot whales (*Globicephala macrorhynchus*). The researchers reported a increasing incidence of strandings in the 1980s and 90s. When the cause of the stranding could be identified, the ratio of natural to human related causes were 1.2 to 1. The most common natural category was dependent calve. The most common human related causes was entanglement and accidental capture followed by animals being shot or speared.[543]

Available observer data from the U.S. pelagic longline fleet operations suggests interactions with marine mammals are very limited. The only marine mammal interaction in the wider-Caribbean during 1992-97 was a pilot whale off the eastern coast of Florida which was released alive (appendix G2e1). Observer program managers believe that the reports from their personnel are very strong evidence that U.S. longline interactions with marine mammal are not significant in the wider-Caribbean.[544]

F. Seabirds

Little information is available on fishery interactions with seabirds off Puerto Rico. Considerable information, however, exists on bird populations and behavior--much more than is available on seabird populations on most other Caribbean islands. Puerto Rico and associated islands is of some importance as an area for seabird nesting. One Caribbean overview lists 13 seabirds as nesting on Puerto Rico or associated offshore islands (appendix G3).[545] Several of these species have been studied in detail. Some of the seabirds studied in the greatest detail include shearwaters (*Puffinus sp.*), gulls (*Larus sp.*), Brown Pelicans (*Pelecanus occidentalis*), and various tern species (*Sterna sp.*), including Brown Noddies (*Anous stolidus*).[546] (Noddies are a type of tern.) One worrying observation is that researchers have detected relatively high levels of heavy metals in seabirds off Puerto Rico, higher level than they anticipated for species feeding in generally non-industrialized areas.[547]

***Photo 38.**--NMFS observers aboard U.S. pelagic longliners have collected data on the catch and bycatch. They have noted few marine mammal interactions and no seabird interactions in the wider-Caribbean. NMFS*

Available research on specific seabirds found on Puerto Rico includes:

Shearwaters: The Audubon Shearwater[548] is a wide-spread pelagic bird with several subspecies. Two subspecies have breeding populations confined to the wider-Caribbean, including the Bahamas.[549] Caribbean populations appear to be declining. Population declines have been reported on islands off Puerto Rico.[550] Other researchers have worked on Audubon Shearwaters on Mona Island.[551]

Terns and noddies: Several

different species of terns and noddies nest in Puerto Rico and offshore islands, including Bridled, Roseate, Sandwich, and Sooty Terns as well as Brown Noddies. One researcher reported that Roseate and Sandwich terns were breeding in southwestern Puerto Rico and feeding on dwarf herring and sardines in coastal lagoons.[552] Another report mentions a tern breeding colony along the eastern coast on Cúlebra Island.[553] Roseate more than Sandwich terns appear to feed in offshore bluewater and may rely on predatory fish and pelicans to increase prey availability.[554] Other information is available on foraging patterns.[555] Canadian researchers have conducted the only long-term study of seabirds in the Caribbean known to the authors. Since 1985, the ecology of Brown Noddies (a small, tropical seabird) has been studied on a cay off Cúlebra, Puerto Rico.[556] The researchers have not reported any serious interactions with local fisheries, many of which are artisanal and based on the use of baited pots. A single noddy has been found dead, entangled in monofilament line, but the line could have come from the many sport fisheries in the area (probably bone fish). It is unlikely that local seabirds directly interact with fisheries offshore either, as most fishermen use hook and lines to catch deeper species such as red snapper.[557] One interesting finding of the study has been the gradual disappearance of Spanish sardines from the diet of the noddies over the 16 years of the study. However, this may represent the effects of natural cycles or a natural event such as a strong hurricane, rather than a fishery impact.[558]

Fishery interactions in the Caribbean have not been a priority for seabird researchers. The authors and seabird specialists consulted know of no studies assessing seabird interactions on fisheries.[559] The primary threat to Caribbean seabirds in the heavily populated Caribbean has been human encroachment. Seabirds are especially vulnerable in rookeries. Not only direct human predation, but species associated with humans such as rats and feral cats and pigs have proven destructive. In addition Caribbean fishermen have traditionally used methods and gear with limited fishing potential. Thus fishery interactions have not been a priority for seabird researchers. One 1984 assessment did not view fisheries as a major threat on Puerto Rico or other Caribbean islands, except possibly off Venezuela.[560] This may have been a fair assessment in the 1980s, except that little is known about Asian longliners which had been operating in the Caribbean since the 1960s. The subject of seabird interactions in the Caribbean probably needs to be reassessed in the 2000s. The nature of Caribbean fisheries have changed substantially since the 1980s. The artisanal fishermen have in most islands increased their fishing capacity with new boats and powerful outboards and new gear like monofilament gillnets. Commercial operations have also expanded with several islands launching longline fisheries.

Available observer data from the U.S. pelagic longline fleet operations suggests longline interactions with seabirds do not occur or are very limited. Observers on U.S. longliners have reported no such interactions during 1992-97 (appendix G2e1). Observer program managers believe that the observer reports are very strong evidence that seabird interactions with longlines are just not occurring in the wider-Caribbean.[561]

Seabird behavior, for a variety of reasons, is generally quite different in the tropics than in the higher latitudes where serious bird interactions have been reported. Temperate birds tend to be good swimmers and divers and weaker flyers while tropical birds are more likely to be good flyers and weaker swimmers. This significantly reduces vulnerability to many fisheries.[562] Based on the feeding behavior of many tropical species, one would not expect there to be significant tern interactions with fisheries. Terns feed by dipping and seizing at the surface. Shearwater and gull interactions, however, are possible. Shearwaters are, for example, known to be taken as bycatch in both the Alaska longline and trawl fisheries. Thus it seems likely that interactions would occur in other areas where shearwaters are present around these fisheries. Shearwaters are typically offshore species, but this is not the case for Audubon's Shearwaters. Thus interactions with near shore gillnet fisheries that artisanal fishermen might deploy are possible.[563] Some of the bird species known to be of greatest risk to longline fishing, such as albatrosses are not generally found in a band of tropical latitudes, in part because the wind conditions needed for the birds to stay aloft are not present.

XVI. International

A. International relations

1. Multilateral

Puerto Rico does not directly belong to international organizations. As a U.S. Commonwealth, it is represented by the U.S. delegations to such organizations as FAO, ICCAT, and WECAFC.

ICCAT: The United States is an active participant in ICCAT and has strongly promoted ICCAT actions to more effectively manage stocks of swordfish and other oceanic pelagics.[564]

WECAFC: The FAO regional fisheries commission, the Western Central Atlantic Fisheries Commission (WECAFC) actively promoted development and cooperative programs during the 1970s and 1980s. Much of the activity focused on artisanal and small-scale commercial fisheries and demersal species. Recent WECAFC activities have been limited by financial difficulties experienced by FAO and a lack of commitment by many Caribbean countries.

2. Bilateral

Several foreign countries fish in U.S. 200-mile wider-Caribbean EEZ (figure 35). The U.S. wider-Caribbean EEZ includes the waters around both Puerto Rico and the U.S. Virgin Islands. The EEZ includes areas of four ICCAT statistical areas or squares, especially 1560 and 1565.[565] The United States has greater enforcement capabilities than other Caribbean countries. As a result, foreign fishing after the United States implemented a 200-mile zone in 1977 has been very limited in the U.S. areas the four ICCAT areas.

2070: Foreign activity in this ICCAT area is discussed in the Turks and Caicos chapter of this report.

2065: This is the area northeast of the Dominican Republic and includes the offshore Plata and Navidad Banks. It also includes northern portion of the U.S. EEZ. Much of the Dominican northern EEZ projects northeast into this ICCAT square (figure 35). The U.S. wider-Caribbean EEZ only extends into the southern part of this zone. Foreign activity in this area is discussed in the Dominican Republic chapter of this report.

1565: ICCAT area 1565 includes both the EEZs of the Dominican Republic and the United States. Most of the U.S. wider-Caribbean EEZ falls in this area and 1560. It is the area discussed in this chapter.

1560: The western area of ICCAT area 1560 is part of the U.S. EEZ, primarily around the U.S. Virgin Islands. The central and eastern area is divided among the several island jurisdictions of the Leeward Islands. Foreign activity is discussed in the Anguilla chapter of this report.

Puerto Rico has had a variety of fishery contacts with foreign countries. Many of these contacts have been conducted through the State Department, but in some cases Commonwealth officials have had direct contacts.

BVI: Puerto Rican officials in 1991 reported working with British Virgin Islands (BVI) officials to develop compatible fishery regulations.[566] The United States negotiated a marine boundary agreement with the United Kingdom (for the BVI) in 1994.[567] There have, however, been few contacts with BVI officials in recent years.[568]

Cuba: Cuba deployed the largest commercial longline fleet of any Caribbean island. The fleet was deployed in the mid-1960s. Operations within the Caribbean basin, however, have been very limited, other than within Cuban waters.[569] Very little Cuban fishing has been noted in the eastern Caribbean. Cuba reports no fishing activity in ICCAT zone 1565 immediately around Puerto Rico. The Cubans do fish extensively outside the Antillean arc east of

Photo 39.--U.S. longline fishermen primarily target swordfish. The Asian longline fishermen have mostly targeted tunas and taken swordfish as a bycatch. NMFS Observer Program

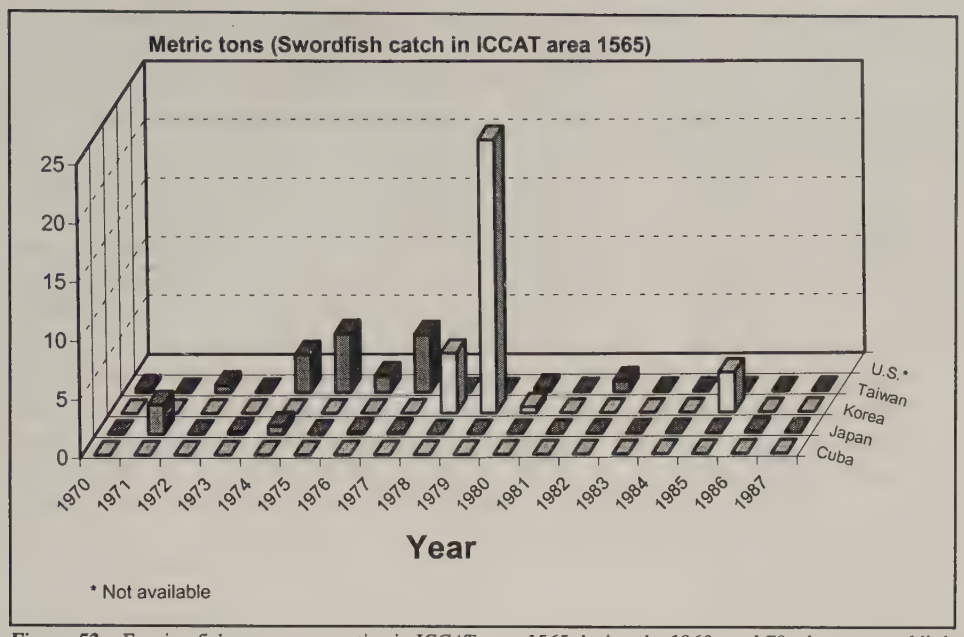

Figure 52.--Foreign fishermen were active in ICCAT area 1565 during the 1960s and 70s, but reported little fishing in the 1980s and none in the 1990s.

the Caribbean in the Atlantic (Caribbean Overview, appendix D3).

Dominican Republic: Puerto Rican officials during the late 1970s discussed a variety of possible fishery arrangements with Dominican Republic officials.[570] Officials from the two countries discussed fisheries access and other issues in 1982.[571]

Honduras: The U.S. Embassy in Tegucigalpa during 1990 inquired about possible Puerto Rican fishing off Honduras. Honduran officials expressed some concern over licensing Puerto Rican vessels and suggested that the fishermen consider a joint venture approach.[572]

Japan: Japan deployed a large longline fleet in the 1960s which reported extensive Caribbean operations. The Japanese first operated in ICCAT area 1565 during 1962 and regularly fished there until 1977 when the United States implement its 200-mile EEZ. After 1977, Japan only reported operations in area 1565 in 1986. Swordfish bycatches in the early and mid 1960s were of some consequence. The peak year was 1966 when they caught over 14 t of swordfish. After 1966, however, only minor catches were generally reported. Much of the Japanese activity was in the second and third quarters of each year. After 1966, fishing was mostly conducted during the third quarter. There has been no Japanese fishing since 1986 (appendix D5).

Korea: Korean longline fishermen have also been active in the Atlantic. The first Korean fishing in area 1565 was reported in 1978. Korean fishermen reported a notable catch over 23 t of swordfish in 1979. Minimal fishing was reported in 1980-81. The last Korean operations were reported in 1985. The Koreans operated throughout the year, although fishing was less intensive during the first quarter (appendix D5).

Netherlands Antilles: The U.S. Consulate General in Curaçao during 1990 inquired about possible access to the grounds on the Saba Bank for Puerto Rican fishermen. Netherlands Antilles (NA) officials explained that a committee had been appointed to assess fisheries legislation and licensing was one subject under consideration. The NA did not implement controls over foreign fishing during the 1980s, in part because of constitutional issues between the role of the island and central governments. NA officials indicated that they would be very strict with any foreign fishermen operating within the 12-mile limit. A formal fisheries agreement concerning Saba would have to be negotiated with Dutch officials.[573] During the 1980s and early 90s, however, foreign fishermen operated on the Saba Bank. The NA Central Government in 1993 established an Exclusive Fishing Zone (EFZ) which included Saba Bank. As the NA is not a OECS member, the islands in the eastern Caribbean are not part of the OECS zone.[574]

Spain: Spanish longline fishermen do not operate as far west as the Caribbean (appendix D5). Spanish fishermen discussed possible fisheries investments with Puerto Rican officials in 1978.[575] The Spanish interest proved to be primarily access to the U.S. 200-mile Fisheries Conservation Zone rather than investments in Puerto Rico.[576] Thus no actual project proved possible. Spanish tuna fishermen in 2001 expressed an interest in operating longliners from Mayagüez and selling the catch to local canneries.[577] Many Spanish longline fishermen have lost access to traditional grounds off Morocco and are looking for alterative fishing grounds. One Puerto Rican entrepreneur sees this as a way to develop the Puerto Rican fishing fleet. In addition he says that working aboard Spanish vessels would make it easy for local fishermen to learn longline fishing methods.[578] U.S. regulations concerning vessel ownership, permit requirement, and limitations to U.S.-built boats would seem to preclude such an operation. Spanish longliners have not operated in the wider-Caribbean, although

they have been deployed on more distant grounds such as the eastern Pacific.[579]

Taiwan: Taiwan, like the Japanese, initiated Caribbean-area longline operations in the 1960s. The primary Taiwan activity has been to the north of the Caribbean, outside the Antillean Arc. Taiwan fishermen have operated extensively around Bermuda, where they have targeted albacore to supply Puerto Rican canneries packing "white meat" tuna.[580] Many of the vessels have operated out of St. Maarten.[581] The Taiwan-owned vessels operating from St. Maarten are not all flagged in Taiwan, instead most have flag-of-convenience registrations (Netherlands Antilles, appendix A3). Available evidence suggests that Taiwan longliners are not extensively fishing Caribbean waters, but are using Caribbean ports to transship their catch and maintain their fleet. Taiwan vessels in the mid-1980s began expanding transshipping activities out of Port-of-Spain.[582] The vessels, however, do not appear to be the longliners targeting albacore to the north of the Caribbean. The Taiwan fishermen do not appear to be very active in the Caribbean itself, but may set opportunistically in waters adjacent to the U.S. Caribbean EEZ while in transit between their fishing grounds and Caribbean transshipment points. In the case of Puerto Rico, this would be primarily the transshipment facilities at St. Maarten. Taiwan fishermen have reported some operations in ICCAT area 1565. The first Taiwan catches were reported in 1968 and they caught 10 t of swordfish. They subsequently reduced fishing effort, although catches as high as 5 t were reported in the mid-1970s. Operations since the United States imposed its 200-mile EEZ in 1977 have been very limited. The last Taiwan catches were reported in 1982. The Taiwan fishermen operated throughout the year, but the most intensive operations were generally reported in the fourth quarter (appendix D5).

Turks and Caicos: Puerto Rican-based fishermen have expressed some interest in fishing in Turks and Caicos waters. Some incidents involving unlicensed Puerto Rican fishing have occurred, most notably in 1990. (See: "XVII. Enforcement.") Puerto Rican fishing interests subsequently attempted to discuss access, but TCI officials remained reluctant to make any commitments because of local concern over foreign fishing.[583] (See: "XVII. Enforcement" for further details on vessel incidents.)

Venezuela: The U.S. Embassy in Caracas during 1990 inquired about possible Puerto Rican fishing off Aves islands. The Venezuelan reply, if any, is not available. Several Venezuelan longliners work out of St. Maarten (Netherlands Antilles, appendix A3). Presumably some of their landings there, especially the albacore, are transhipped to Puerto Rican canneries. This product may show up in U.S. import data as imports from the Netherlands Antilles rather than Venezuela.

The Caribbean Fisheries Management Council (CFMC) is responsible for the managing fisheries in the EEZ around Puerto Rico and the Virgin Islands. While a Federal agency, the CFMC is largely made up of Puerto Ricans and Virgin Islanders who are concerned with issues associated with local fishermen. The CFMC has made an effort to develop working relationships with fishery officials on neighboring islands and in some cases the Caribbean in general. There primary concern has been the species targeted by Puerto Rican and Virgin Island fishermen, especially reef fish and lobster. The CFMC has made little effort to address issues associated with oceanic pelagics as these species are of relatively minor interest to local fishermen.[584]

B. Joint ventures

The authors know of few joint-fishery ventures in Puerto Rico with foreign fishing companies and none which deal with swordfish.

Dominican Republic: The Puerto Rican Commonwealth Government in 1985 help finance a joint tuna processing venture at Manzanillo in the Dominican Republic. The project was based on the twin-plant concept where low-paid Dominican workers would prepare tuna for canning at Puerto Rican canneries.[585]

Indonesia: An Indonesian company purchased one of Puerto Rico's Japanese-owned tuna canneries.

Japan: Japanese companies operated tuna canneries in Mayagüez and Ponce during the 1980s and early 1990s.

XVII. Enforcement

The NMFS Enforcement Office in Puerto Rico works closely with both the U.S. Coast Guard and the Puerto Rican Department of Natural Resources (DRNA). Many of the issues faced in Puerto Rico deal with domestic fishermen and as a result NMFS and DRNA cooperate closely. One of the most difficult issues pursued by the NMFS Office of Enforcement in recent years has been the new management regime for highly migratory species adoption in the 1999 Final Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks.[586] (Often referred to as the HMS Plan.) The new regulations have affected both fishermen and seafood dealers.

Fishermen: The exemption for artisanal fishermen was dropped and the domestic artisanal fishermen can no longer land billfish. In addition a NMFS permit is required to land swordfish and tuna. Few swordfish were taken by the domestic fishermen, but many do take tuna.

Seafood dealers: Another issue has been the requirement to obtain a dealer permit to sell swordfish and tuna. This pertains only to fish purchased from fishermen. Dealers who import seafood do not need these permits.

NMFS and DRNA have made a concerted effort to inform the fishermen and seafood dealers of the new regulations. Many fishermen have now applied and received the needed general tuna permits (appendix A5). NMFS enforcement agents, however, continue to report that some fishermen are still taking yellowfin tuna without the necessary tuna permit. During 3 months of 2001, NMFS reports that four cases regarding the illegal catch of yellowfin without a permit were being processed in the NMFS San Juan Field Office.[587] There are two companies which now have swordfish dealer permits and seven companies which have tuna a permits (appendices E2a-b). Atlantic billfish sales are strictly prohibited. Officials are concerned about the limited supervision of longline landings. Another problem is that artisanal and recreational fishermen will sometimes attempt to sell billfish they have taken. Such sales are illegal. NMFS enforcement agents have given more attention to who can legally purchase fish and have made more dock-side inspections.[588] NMFS enforcement agents also interview the mainland longline captains that dock at Pier 5 in San Juan. Agents are planning a system that will allow the interviews to take place more regularly when the captain docks his vessel.[589]

Enforcement agents are engaged in a wide variety of other tasks. One of the greatest concerns are efforts to protect endangered sea turtles. Officials report occasional arrests of mostly artisanal fishermen who attempt to land and sell sea turtles. One such incident was reported in June 2001.[590]

Several incidents involving foreign countries have been reported. Only a few scattered details are available on these incidents. None of these incidents, however, appear to have involved the swordfish fishery.

Off other islands: Puerto Rican fishermen operate primarily in their own coastal waters, but a few also fish off other Caribbean islands. These fishermen generally do not purchase foreign fishing licenses and, as a result, some have been seized by foreign enforcement authorities.

Off Puerto Rico: There were no U.S. Coast Guard (USCG) seizures of foreign fishing vessels in U.S. Caribbean waters during 1987-96.[591] A Venezuelan longliner was seized in 1999.[592]

Available information on incidents with individual foreign countries is as follows:

Bahamas: The Royal Bahamian Defense Force (RBDF) seized the 12 m Puerto Rican fishing vessel *Victoria I* in 1993 off Great Iguana. The vessel was fishing snapper without a license. The vessel attempted to evade capture and the RBDF shot a crew member.[593]

British Virgin Islands: Occasional incidents involving artisanal fishermen are reported with the BVI.

Colombia: The USCG seized a Colombian fishing boat carrying cocaine in 1987.[594]

Dominican Republic: Many of the incidents with foreign countries involve the Dominican Republic (DR). Much of the Puerto Rican artisanal catch is taken along the island's western coast, giving rise to occasional incidents with the Dominicans. DR officials, for example, seized the 13 m Puerto Rican fishing boat *El Monseratte* in July, 1978. The fishermen were fined $50 each.[595] DR officials also seized the *Antares* in 1978.[596]

Spain: The USCG seized the Spanish fishing vessel *Cieisa Once* on March 16, 1978. The vessel's master was prosecuted for trying to sell his catch illegally in the United States. The vessel was being delivered to a Mexican company which planned to deploy it in fisheries off the U.S. coast.[597]

Turks and Caicos: Two Puerto Rican-based vessels (*Griselle* and *Strombull*) were seized April 3, 1990 and subsequently confiscated for illegally fishing in TCI waters. The crews were sentenced to 6-month prison terms in lieu of fines.

Venezuela: The USCG on August 1, 1999, seized the

Venezuelan longliner *Gaviota* fishing about 240 km south of Puerto Rico, 30 km within the U.S. EEZ. About 4 t of bluefin and albacore tuna were found in the hold. The vessel was escorted to San Juan. The master gave no explanation of why he was fishing in the U.S. EEZ.[598] Another recent report indicated that a seized Venezuelan longliner had 2 t of yellowfin tuna and six marlins (two blues and four whites). The vessel was a converted yacht. The catch was confiscated, the crew deported, and the owner fined.[599]

XVIII. Future Trends

Puerto Rico has only a small, mostly artisanal fishing industry. Island fishermen have focused primarily on inshore demersal fisheries which are now heavily exploited. Officials believe that new fishery regulations which they hope to gain approval for in 2001 will enable them to better regulate the fishery. Fishermen in recent years have been expanding catches of pelagic species, but this sector is still a relatively small part of the overall fishery. Relatively small quantities of tuna are taken by the domestic fishermen, but catches have been increasing. Swordfish catches are quite rare. About 100 fishermen currently are involved in small scale trolling for tuna, dorado, and other pelagics. There seems to be little interest on the part of these fishermen to shift to commercial longlining. The authors know of no projects underway by Puerto Ricans desiring to enter the longline fishery for swordfish and other oceanic pelagics. New regulations under consideration in 2001 may place severe limitations on longlining. The Federal HMS management plan introduced in 1999 will in fact make it even more difficult for Puerto Rican fishermen to enter the fishery in the future. Any new commercial longline fisherman in Puerto Rico are elsewhere in the United States now has to buy a tuna or swordfish permit from a current holder.

Substantial numbers of mainland fishermen have operated commercial longliners for swordfish and tuna seasonally out of San Juan since 1984. Relatively large numbers of U.S. fishermen have operated from San Juan, at times more than 50 longliners. In recent years the number has declined. Currently only about four mainland longliners are active. Effort out of San Juan has declined due to catch rates, fish prices, fuel costs, and a variety of other factors.

The mainland fishermen have had little impact on the local fishery. This contrasts with Brazil, Venezuela, and several Caribbean islands where U.S. fishermen have played an important role in developing a local longline fishery. A few Puerto Rican fishermen have experimented with commercial longlines, but with little success. While a few artisanal fishermen used longlines, mostly demersal gear, there are no Puerto Rican commercial longliners. The primary impact of the mainland longline fishermen has been on the Puerto Rican seafood market. The sale of bycatch as well as the targeted species of these fishermen on the island has helped supply local markets. It appears to have been instrumental for expanding the market for pelagic species. Notably as mainland landings on the island have declined, dealers have begun to import swordfish to fill the local demand.

* * * *

Note: This chapter involved extensive Spanish-language interviews of Puerto Rican fishing companies and artisanal fishermen. Many of the interviews were conducted by Ms. Melanie Arce, a senior at John F. Kennedy High School in Wheaton, Maryland. She worked with the National Marine Fisheries Service through the Montgomery County High School/High Tech Program. Ms. Arce may major in marine biology when she begins her university studies in 2002.

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Endnotes

SECTION I. (Overview)

1. NMFS, *Fisheries of the United Sates* (NMFS: Silver Spring, Maryland, 2000), p. 21. The Puerto Rican fishery is best described as an artisanal fishery. The authors throughout the swordfish series has used the term "artisanal" to mean small-scale fishing with basic technology and "commercial" to mean larger-scale operations with more advanced technology. In Puerto Rico and many other Caribbean islands, however, the term "commercial" is used to mean any fishing operations in which the fishermen markets the catch, differentiating it from subsistence fishing. Thus what we report as artisanal may be described as commercial in the various sources consulted.
2. J.J. Kimmel and R.S. Appeldoorn, "A critical review of fisheries and fisheries management policy in Puerto Rico," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 41 (GCFI: Charleston, S.C., 1992), pp. 349-360.
3. Roy Armstrong, Bio-Optical Oceanographic Laboratory (BIOL) at the University of Puerto Rico-Mayagüez, personal communications, May 16, 2001. There are limitations on how the remote sensing work (photo 4) can be displayed in a black and white publication. Readers are advised to access the BIOL website which has posted colorized versions of their imagery: http://cacique.uprm.edu/biol/images.html
4. D.V. Bogdanov, V.A. Sokolov, and N.S. Khromov, "Regions of biological and commercial productivity in the Gulf of Mexico and Caribbean Sea," *Oceanology*, Vol. 8, 1968, pp. 371-381.
5. Jaime Gonzalez, Oficina de Programa para el Fomento y Desarrollo de la Administración Pesquera, Departamento de Agricultura, Estado Libre Asociado de Puerto Rico, personal communications, June 21, 1999.
6. Daniel Matos Caraballo, "Overview of Puerto Rico's small-scale fishery statistics, 1994-97," submitted to GCFI for publication, November 9, 1998, p. 1.
7. Craig Lilyestrom, Chief, Marine Resources, Department of Natural and Environmental Resources, Commonwealth of Puerto Rico, personal communications, June 18, 1999.
8. Daniel Matos Caraballo, "Status of the fishery in Puerto Rico, 1990-93," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 47, 1994.
9. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-186.
10. José Campos, Puerto Rican Angling, personal communications, July 31, 2001. Campos was previously Director of Navigation in Puerto Rico.
11. Lilyestrom, *op. cit.*, June 18, 1999.
12. Daniel Matos-Caraballo, "Puerto Rico fishery census 1995-96," paper submitted to the Gulf and Caribbean Fisheries Institute, November 9, 1998.
13. Lilyestrom, *op. cit.*, May 22, 2001.
14. Richard Appeldoorn and Stephen Meyers, "Puerto Rico and Hispaniola," in "Marine Resources of the Antilles," *FAO Fisheries Technical Paper*, No. 326 (FAO: Rome, 1993), p. 121 and C.W. Boardman and D. Weiler, "Aspects of the life history of three deep-water snappers around Puerto Rico," *Gulf and Caribbean Fisheries Institute Proceedings*, Vol. 32 (GCFI: 1980), pp. 158-172.
15. Appeldoorn and Meyers, "Puerto Rico and Hispaniola, *op. cit.*, p. 124.
16. FAO, *Yearbook of Fishery Statistics*, 1988, p. 607.
17. NMFS, *Fisheries of the United States*, various years.
18. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.*, pp. 110-111.
19. Joe Kimmel, NMFS, personal communications, May 12, 2001.
20. Willard N. Brownell, "Fisheries of the Virgin Islands," *Commercial Fisheries Review*, reprint no. 924, p. 23. Brownell sites exploratory fishing reported by the Puerto Rican Department of Agriculture, the UNDP/FAO Caribbean Fishery Development project, NMFS exploratory cruises, and the Japanese fishing operation based in St. Maarten, Netherlands Antilles.
21. David A. Olsen and Joseph A. La Place, "Demonstration of advances in Virgin Islands small boat fishing techniques," *Marine Fisheries Review*, Vol. 43 (11), November, 1981, pp. 11-15.
22. Matos Caraballo, "Status of the fishery in Puerto Rico, 1990-93" *op. cit.*, Institute, p.1.

23. T.R. Tosteson, D.L. Ballantine, and H.D. Durst, "Seasonal frequency of ciguatoxic barracuda in southwest Puerto Rico," *Toxicon*, vol. 26, no. 9, 1988, pp. 795-801.
24. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.*, pp. 151-152.
25. Colón, *op. cit.*, June 13, 2001.
26. Throughout these reports we have used FAO data, based in data submitted by individual countries, to estimate the trade in fishery products. This was not possible for Puerto Rico. FAO lists Puerto Rican catch data (appendix D1a), but not trade data. Presumably the inclusion of Puerto Rico within the U.S. Customs area created problems for listing it separately.
27. Annual reports are available at http://www.census.gov/prod/www/abs/ftdpr895.html
28. R.S. Appeldoorn, G.D. Dennis, and O. Monterrosa, "Review of the shared demersal resources of Puerto Rico and the Lesser Antilles region," in "Report and proceedings of the Expert Consultation on Shared Fishery Resources of the Lesser Antilles Region," *FAO Fisheries Report*, no. 383 (FAO: Rome, 1986), pp. 36-106.
29. Robert E. O'Brien, *A Study of Establishing a Distant-water Fishing Industry in Puerto Rico* EDA Project No. 01-6-09375 (EDA Technical Assistance Project: Washington, D.C., 1972), p. 5.
30. See the Netherlands Antilles chapter of this report for details on the transshipping operation at St. Maarten.
31. Rolf Juhl, "Problems of the tuna industry in Puerto Rico," NMFS memorandum, February 26, 1981.
32. "Tuna," *Seafood International*, February 1991, p. 9.
33. "Cierre planta atunera," *Boletín Informativo SIM*, September 1995, p. 20.
34. See for example, Alan Patureau, "Tuna industry periled by CBI, fuel costs," *San Juan Star*, April 4, 1982 and Larry Rohter, "Trade pact threatens Puerto Rico's economic rise," *New York Times*, January 3, 1993.

SECTION II. (Species)

35. Tim Malley, MacLean's Seafoods, letter to the editor, *Seafood Leader*, May-June, 1995, pp. 6-7.
36. Donald S. Erdman, "Spawning patterns of fishes from the northeastern Caribbean," *Contribuciones Agropecuarias y Pesqueras*, Vol. VIII, No. 2, July, 1976, 37p.
37. Rolf Juhl, Martin R. Barlett, and Bruce Maghan, "Exploratory fishing in the western tropical Atlantic by the tuna seiners *Normandie* and *Queen Marry*," *Contribuciones Agropecuarias y Pesqueras*, Vol. II, No. 4, June 1970 and Llena Sang García, *Aspects of the Reproduction and Embryopnic Development of the Gulper Shark, Centrophhorus granulosus (Elasmobranchii, Squalidae), in Puerto Rico With Notes on Its Biology*, 107p., as cited in *Contribuciones*, Vol. 30, 1992, pp. 294-295.
38. G.A. Rivera and R.S. Appeldoorn, "Age and growth of dolphin fish. *Coryphaena hippurus*, off Puerto Rico," *Fishery Bulletin*, April 2000, Vol. 98, no. 2, pp. 345-352.
39. Jean Cramer, "Large pelagic logbook newsletter - 1994," *NOAA Technical Memorandum* (NMFS-SEFSC-378), November 1995, p. 12.
40. Charlene Grall and Donald P. de Sylva, "Distribution, relative abundance, and seasonality of swordfish larvae," *Transactions of the American Fisheries Society*, Vol. 112, 1983, 239, 243-244.
41. John Jeffrey Govoni, Bruce Stender, and Oleg Pasuk, "Distribution of larval swordfish, *Xiphias gladius,* and probable spawning off the southeastern United States," in press, advanced copy provided the authors in November 1998.
42. Cramer, "Large pelagic logbook newsletter - 1994," *op. cit.*, pp. 9-13.
43. See the Cuban chapter of this report for details. Cuban authors do describe some limited operations off the northwest and southwest coast. The Cubans have not tagged swordfish nor have any U.S. swordfish tags bee returned by the Cubans even though their fishery must have taken some swordfish that have been tagged by U.S. fishermen and researchers.
44. See the Cuban chapter of his report for a fuller discussion of possible migratory movement.
45. Barbara Block, "Satellite and archival tagging of highly migratory fish in the Atlantic," summary in ICCAT Tuna Symposium, *Collected Volume of Scientific Papers*, L (1), 1998, p. 235.

SECTION III. (Grounds)

46. Matthias Tomczak and J. Stuart Godfrey, *Regional Oceanography: An Introduction* (Pergamon: London, 1994), pp. 310-317.
47. Christopher N.K. Mooers and George A. Maul, "Intra-Americas Sea circulation," ch. 7, in Allan R. Robinson and Kenneth H. Brink, eds. *The Sea*, Vol. II (John Wiley & Sons: 1998), pp. 183-208.
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49. Roy Armstrong, UPR, personal communication, May 16, 2001. Armstrong is interested in doing some oceanographic research on the current flow around Puerto Rico.
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53. While the authors know of few studies in the Caribbean assessing the relationship between the current structure and swordfish and other oceanic pelagics, a recent Portuguese assessing that relationship in the Azorian Current provides important insights into possible relationships between these species and currents. Mário Alves, "The Azores Front-Current system and large pelagic fish behavior," ICCAT Tuna Symposium, *ICCAT Collective Volume of Scientific Papers*, L (1), 1998, pp. 381-391.
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55. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.,* p. 108.
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58. R.W. Rodriguez, R.M.T. Webb, and D.M. Bush, "Another look at the impact of Hurricane Hugo on the shelf and coastal resources of Puerto Rico, USA," *Journal of Coastal Research*, vol. 10, no. 2, 1994, pp. 278-296.
59. For details see the U.S. Virgin Islands chapter of this report.
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62. Armstrong, *op. cit.*, May 16, 2001.
63. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.,* p. 105.
64. Kimmel, *op. cit,* May 22, 2001.
65. M.D. Richardson, K.B. Briggs, F.A. Bowles, and J.H. Tietjen, "A depauperate benthic assemblage from the nutrient-poor sediments of the Puerto Rico Trench," *Deep Sea Research* I. Oceanographic Research Papers vol. 42, no. 3, 1995, pp. 351-364.
66. For details see the Dominican Republic chapter of this report.
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68. Several authors have noted the relatively limited potential of Puerto Rican fisheries. See for example A. Holmsen, "Low production and old methods in Puerto Rican inshore fishery," *Maritimes*, Vol. 11, No. 1, 1967, pp. 5-7; and José Suárez Caabro, *El Mar de Puerto Rico: Una Introducción a las Pesquerias de la Isla*, (Universidad de Puerto Rico: Rio Piedras, 1979), 259p; and Maria Riesco, Sea Grant Fisheries Products Coordinator, University of Puerto Rico, personal communications, April 27, 1999.
69. Michael Dallarosa, Enforcement Agent, NMFS, personal communications, April 21, 1999.
70. J. Gonzalez, *op. cit.*, June 21, 1999.
71. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.,* p. 105.
72. Deborah Weiler and José A. Suárez-Caabro, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1972-1978," *CODREMAR Informe Técnico*, Vol, 1, No. 1, Vol, 1986, p. 7.
73. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 5.
74. Daniel Matos Caraballo and Yvonne Sadovy, *Commercial Fisheries Statistics: Interjuridictional Fisheries Program, CODREMAR/NMFS* (CODREMAR, San Juan, July, 1989), table 5, p. 21.
75. The available species by coast catch data is dated. While the general pattern has probably not changed, the more current data is needed.
76. Daniel Matos Caraballo, Fisheries Research Laboratory, personal communications, May 10, 2001.
77. For details see "VI. Gear and Methods".
78. Lilyestrom, *op. cit.,* June 18, 1999.
79. Lilyestrom, *op. cit.*, personal communications, June 18, 1999 and J. Gonzales, *op. cit.*, June 21, 1999.
80. Miguel Rolón, Executive Director, Caribbean Fishery Management Council, personal communications, April 15, 1999.
81. Lilyestrom, *op. cit.*, June 18, 1999.

82. Tim Malley, Production Manager, MacLean's Seafoods, personal communications, February 8, 1996.
83. Jaime González, Director, Fishery Development Program, personal communications, Department of Agriculture, Commonwealth of Puerto Rico, January 24, 1996.
84. Jean Cramer, "Large pelagic logbook newsletter -1994," *NOAA Technical Memorandum*, NMFS-SEFSC-378 (NMFS/Southeast Fisheries Science Center: Miami, November 1995), p. 3. For a more detailed assessment of U.S. fishing in the Caribbean, see the Caribbean overview.
85. Joe Weeks, Assistant Captain, *Edward G*, personal communications, March 22, 1996.
86. Jean Cramer, "Large pelagic logbook newsletter - 1993," *NOAA Technical Memorandum* (NMFS-SEFSC-352), August, 1994), p. 2.
87. Cramer, "Large pelagic logbook newsletter - 1993," *op. cit.*, p. 2.
88. Cramer, "Large pelagic logbook newsletter - 1993," *op. cit.*, p. 3.
89. Cramer, "Large pelagic logbook newsletter - 1994", *op. cit.*, p. 3.
90. Jean Cramer, "Large pelagic logbook newsletter - 1995", *NOAA Technical Memorandum*, (NMFS-SEFSC-394), November 1996, p. 3.
91. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1996", *NOAA Technical Memorandum*, (NMFS-SEFSC-407), January 1998, p. 3.
92. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1997", *NOAA Technical Memorandum*, (NMFS-SEFSC-420), January 1999, p. 3.
93. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1998", *NOAA Technical Memorandum*, (NMFS-SEFSC-433), January 2000, p. 3.
94. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter - 1999", *NOAA Technical Memorandum*, (NMFS-SEFSC-452), January 2001, p. 3.

SECTION IV. (Fleet)

95. Daniel Matos Caraballo, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, p. 2.
96. Daniel Matos Caraballo, Supervisor of Fishery Statistics, Laboratorio de Pesca, Departamento de Recursos Naturales, personal communications, January 24, 1996.
97. J. Gonzales, *op. cit.*, June 21, 1999.
98. José Campos, Director, Comisionado de Navegación, Departamento de Recursos Naturales, personal communications, February 8, 1996.
99. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 4.
100. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 5.
101. Dallarosa, *op. cit.*, June 4, 1999.
102. Campos, *op. cit.*, February 8, 1995.
103. Pedro Arce, fisherman, personal communications, July 13, 2001.
104. Luis Esteves Quiñones, fisherman, personal communications, July 20, 2001.
105. Rafael Martín, fisherman, personal communications, July 16, 2001.
106. J. González, *op. cit.*, January 24, 1996. "Usufructo" or in English "usufruct" is a use right that falls short of a transferable (hereditary) property right. The term originated as part of the European feudal system and was commonly associated with land use rights. Bob Wemyss, Secretary, North Shore Baymen's Association, "Usufruct," posting on Fishfolk, September 12, 2001. Fishing rights could also be involved and in Puerto Rico, some municipalities have expanded this by purchasing improved small boats for which the fishermen pay fees. The boats remain the property of the municipality.
107. Rolón, *op. cit.*, April 15, 1999.
108. Edgardo Ojeda, Especialista en Pesqueria, Puerto Rico Sea Grant, personal communications, April 23, 2001.
109. Matos Caraballo, *op. cit.*, May 10, 2001.
110. Rolón, *op. cit.*, April 15, 1999.
111. Ojeda, *op. cit.*, April 23, 2001.
112. Matos Caraballo, *op. cit.*, April 21, 1999.
113. Matos Caraballo, *op. cit.*, May 10, 2001.
114. Dallarosa, *op. cit.*, June 4, 1999.
115. Dallarosa, *op. cit.*, June 4, 1999.
116. This is based on interviews of a random sampling of the fishermen during July 2001. The fishermen interviewed are listed in the "Sources" section. The interviews were conducted by Melanie Arce.

117. The author indicated, "The indicators of that increasing demand/disorganized supply are: the increasing number of 'informal' piers, ramps, launching facilities, and sport fishing clubs; the increasing number of coastal settlers (mostly low income) that rent or lease water access and pier space to boaters and recreational fishermen; and the number of fishing villages (or landing centers) providing recreational services as a sideline." M. Valdes-Pizzini, "Marine recreational fisheries development in Puerto Rico and the U.S. Virgin Islands: Strategy and current approaches," *GCFI Proceedings*, Vol. 39 (GCFI: Miami, 1989), pp. 66-71.
118. García Graciela, Special Assistant to the Executive Director for Fisheries Management Development, Caribbean Fisheries Management Council, personal communications, May 9, 2001.
119. Lilyestrom, *op. cit.*, July 3, 2001.
120. Campos, *op. cit.*, February 9, 1996.
121. For details, see the sections on recreational fisheries in the Puerto Rico chapter and in the chapters on the other Caribbean islands.
122. Steve Meyers, NMFS, personal communications, January 25, 2000.
123. José Luis Campos, Miguel A. Rolón, and Omar Muñoz-Roure, "The emergence of a swordfish fishery around Puerto Rico and the Virgin Islands," *GCFI Proceedings*, Vol. 38, (GCFI: Miami, May, 1987), p. 616.
124. Eight of the longliners are 22.5 m in length and the remaining ten vessels are 28.5 meters. Malley, *op. cit.*, February 8, 1996.
125. J. González, *op. cit.*, January 24, 1996.
126. "Gear profiles," *National Fisherman*, March, 1999, p. 43.
127. Weeks, *op. cit.*, March 22, 1996.
128. One observer noted that most of the vessels have crews of about five. Campos, Rolón, and Muñoz-Roure, "The emergence...," *op. cit.*, p. 616. The authors, however, during a March 1996 visit to San Juan noted that many of the larger vessels have six-man crews.
129. Angelo Bertolino, Southeast Fisheries Science Center, NMFS, personal communications, June 14, 2001.
130. Dallarosa, *op. cit.*, June 4, 1999.

SECTION V. (Shipyards)

131. Mahlon Pickering, NMFS Enforcement Agent, personal communications, February 29, 1996.
132. Pickering, *op. cit.*, February 29, 1996.
]133. Matos Caraballo, *op. cit.*, February 23, 1996.
134. Details on the U.S. swordfish fleet and fishery are available in Karyl K. Brewster-Geiz, "United States," *World Swordfish Fisheries*, Vol. V (NMFS: Silver Spring, Maryland, 1997), pp. 63-77.
135. Pickering, *op. cit.*, February 29, 1996.

SECTION VI. (Fleet Operations and Gear)

136. Matos and Sadovy, "Perspectiva ..., 1990" *op. cit.*, p. 3.
137. J. González, *op. cit.*, January 24, 1996.
138. Daniel Matos Caraballo, "Determinando el estado de nuestras pesquerías...", *Boletín Marino*, Programa de Colegio Sea Grant, UPR, Enero-Febrero 1995.
139. Matos Caraballo, " Determinando...", *op. cit.*
140. Caraballo and Sadovy, *Commercial Fisheries Statistics, op. cit.*, appendix 1.
141. A good, but now dated review of the Puerto Rican trap fishery is available in D.K. Stevenson, "Management of a tropical fish pot fishery for maximum sustainable yield," *GCFI Proceedings*, Vol. 30, 1978, pp. 95-115
142. Alejandro Acosta, "A preliminary study of gillnet, trammel net and beach seine catches from southwest Puerto Rico with notes on length-frequency," *Contribuciones*, Vol. 30 (universidad de Puerto Rico, Departamento de Ciencias Marinas: Mayagüez, 1992), pp. 185-186 and Matos Caraballo, "Determinando ...," *op. cit.*, p. 13.
143. Roland Finch, NMFS Director of Fisheries Management, memorandum, "Highlights of Council activities, August, 1983," August 9, 1983, and Daniel Matos, "Determinando el estado de nuestras pesquerías...", *op. cit.*, pp. 12-15.
144. Lilyestrom, *op. cit.*, May 22, 2001. Some information on the Bermuda trap ban is available in the Bermuda chapter of this report.
145. M. Valdez Pizzini, J.M. Posada, K. Grove, M. Rosado, and R.S. Creswell, "Mapping fishing grounds using Global Positioning System (GPS) technology," *Gulf and Caribbean Fisheries Institute Proceedings*, vol. 49, (GCFI: Fort Pierce, Florida, 1997), pp. 125-138.

146. Acosta, "A preliminary study ...," *op. cit.*, pp. 123-149. The author of this report expressed concern that inconsistent sampling effort may have adversely affected the accuracy of the species composition.
147. Matos Caraballo and Sadovy, *Commercial Fisheries Statistics, op. cit.*, table 7, p. 29.
148. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-191.
149. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.*, p. 110.
150. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-188.
151. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-186.
152. Campos, *op. cit.*, July 31, 2001.
153. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-190.
154. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-186.
155. Martin, *op. cit.*, July 16, 2001.
156. Danny Sanabria Roman, fisherman, personal communications, July 13, 2001.
157. Esteves Quiñones, *op. cit.*, July 20, 2001.
158. Martin, *op. cit.*, July 16, 2001.
159. Amado Suarez, fisherman, personal communications, July 16, 2001.
160. Esteves Quiñones, *op. cit.*, July 20, 2001.
161. Rosario, op. cit., July 16, 2001.
162. Sanabria Roman, *op. cit.*, July 13, 2001; Martin, *op. cit.*, July 16, 2001; A. Suarez, *op. cit.*, July 16, 2001; and Esteves Quiñones, *op. cit.*, July 20, 2001.
163. Matos Caraballo and Sadovy, "Perspectiva ..., 1990," *op. cit.*, p. 14.
164. Matos Caraballo, "Status of the fishery ...," *op. cit.*, table 3.
165. Matos, *op. cit.*, May 10, 2001.
166. Pickering, *op. cit.*, February 29, 1996.
167. Matos Caraballo and Sadovy, "Perspectiva ..., 1990," *op. cit.*, p. 14.
168. Matos Caraballo, "Overview of ...," *op. cit.*, tables 3-6.
169. Pickering, *op. cit.*, February 29, 1996.
170. Matos Caraballo, *op. cit.*, April 21, 1999.
171. Rolf Juhl, "Exploratory fishing surveys and gear tests in Puerto Rico," *Contribuciones Agropecuarias y Pesqueras*, Vol. I, No. 1 (second edition), May, 1975, 39p and Rolf Juhl, "A report on exploratory fishing and gear tests in Puerto Rico from 1969 to 1972," *Contribuciones Agropecuarias y Pesqueras*, Vol. IV, No. 3, November, 1972, 63p.
172. G. García, *op. cit.*, May 9, 2001.
173. Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.*, p. 128 and Matos, *op.cit.*, May 10, 2001.
174. Meyers, *op. cit.*, May 9, 2001 and G. García, *op. cit.*, May 9, 2001.
175. Juan Muniz, fisherman, personal communications, July 12, 2001 and Pedro Arce, fisherman, personal communications, July 13, 2001 and Juan Rosario, fisherman, personal communications, July 16, 2001.
176. Arce, *op. cit.*, July 13, 2001.
177. Caribbean Fisheries Management Council (CFMC), "Fishery management plan and environmental impact statement for the coastal pelagic resources," (CFMC: San Juan, 1983), 195p.
178. Muniz, *op. cit.*, July 12, 2001, A. Suarez, *op. cit.*, July 16, 2001, and Rosario, *op. cit.*, July 16, 2001.
179. Matos Caraballo, *op. cit.*, May 10, 2001.
180. Ojeda, *op. cit.*, April 23, 2001.
181. As it is illegal, billfish landings are not reported. There is thus no data on the quantities involved, although estimates can be made based on historical data.
182. Peter Johnson, "Puerto Rico journey: The northwest area," internet site accessed, April 19, 2001: http://www.iit.edu/~PR/prnw.html. As Johnson is not a fisheries specialist, he may have been using swordfish generically to mean billfish. He declined to respond to our request for clarification.
183. Matos, *op. cit.*, May 10, 2001.
184. Dallarosa, *op. cit.*, April 21, 1999.
185. Lilyestrom, *op. cit.*, May 9, 2001.
186. Muniz, *op. cit.*, July 12, 2001.
187. USC Title 50 644.21.
188. J. González, *op. cit.*, January 24, 1996.
189. Ron Rinaldo, NMFS, personal communications, March 8, 1996 and G. García, *op. cit.*, March 13, 1996.
190. Several artisanal fishermen described the fishery over the regulations at a meeting with NMFS and Puerto Rican officials in 1995. Rinaldo, *op. cit.*, March 8, 1996.

191. Detailed information on the status of Atlantic billfish, tunas, swordfish are available in ICCAT, *Report on the Standing Committee on Research and Statistics* (ICCAT: Madrid, October 2-13, 1995), COM/95/25, 163p. The status of stocks has varies significantly from species to species, but some billfish stocks have declined precipitously: blue marlin (p. 50), white marlin (p. 55), and sailfish (p. 60).
192. Elizar Castillo, Presidente, Congreso de Pescadores, personal communications, June 18, 2001.
193. Agricultural Credit Corporation, "Annual progress report: Fisheries statistics," Project 2-260-R-1, August 23, 1976.
194. Mario González, Assistant to the Mayor, Government of Rincón, personal communications, February 23, 1996.
195. Muniz, *op. cit.*, July 12, 2001.
196. Rolón, *op. cit.*, April 15, 1999.
197. Daniel Matos Caraballo, Investigador Principal del Programa de Estadísticas Pesqueras, Laboratorio de Investigaciones Pesqueras de Puerto Rico, personal communications, April 15, 1999.
198. Erdman, "Spawning patterns ...," *op. cit.*, 37p.
199. Kimmel, *op. cit.*, May 22, 2001.
200. J.M. Barrios, E.I. Medina, H. Ferrer, and I. Diaz, "Marine sport fishing creel survey," United States Fish and Wildlife Final Report F-5-6, 1989, 184p.
201. Valdes-Pizzini, "Marine recreational fisheries development ...," *op. cit.*, p. 70.
202. Lilyestrom, *op. cit.*, June 18, 1999.
203. Reglamento para regir las actividades de pesca dentro de las aguas juridiccionales del Estado Libre Asociado de Puerto Rico. The Commonwealth is currently discussing the proposal with the Caribbean Fisheries Management Council and other concerned fishery interests.
204. Lilyestrom, *op. cit.*, May 9, 2001.
205. Alan Lowther, NMFS, personal communications, May 10, 2001.
206. The authors have converted most distances to metric kilometers. As the interviews collected data based on miles, we have left the miles here. The 10 miles refers to the Puerto Rican Commonwealth waters of 9 nautical miles.
207. Robert B. Ditton and Donald J. Clark, "Executive summaries of research completed for the Billfish Foundation: Puerto Rico," internet site accessed May 10, 2001: http://lutra.tamu.edu/hdlab/execpr.htm
208. "'GIGI' dominates La Giaira shootout as all time record for releases falls," *The International Angler*, May-June, 1999, p. 14.
209. WTC charters which operate in the Mona Passage, for example, mentions swordfish. WTS Charters, "Gone fishing: Sportfishing Mona adventures," internet site accessed April 19, 2001: http://www.worldwidefishing.com/puertorico/b607/
210. 50 CFR 635.20
211. Lilyestrom, *op. cit.*, July 3, 2001.
212. Raquel N. Pérez and Yvonne Sadovy, "Preliminary data on landing records and reproductive biology of *Coryphaena hippurus L.*, in Puerto Rico, *Proceedings of the Gulf and Caribbean Fisheries Institute*, Vol. 44, November, 1991 (GCFI: Charleston, S.C., 1996), pp. 652 and 654.
213. "Did you know?" *International Angler*, November-December, 1999, p. 20.
214. IGFA, "Rolex/IGFA 2000 Tournament of Champions," internet posting accessed December 20, 1999: http://www.igfa.org/htdocs/99TOC.html
215. IGFA, "Calendar," *International Angler,* November-December, 1999, p. 19.
216. Santos González, NMFS Special Agent, NMFS memorandum, October 9, 2001.
217. Lilyestrom, *op. cit.*, May 22, 2001.
218. "Did you know?" *International Angler*, November-December, 1999, p. 20.
219. Omar Orraca, "Caribbean Outfitters: Deep sea," internet site accessed May 17, 2001: http://www.fishinginpuertorico.com/captbig.htm
220. Dallarosa, *op. cit.*, June 4, 1999.
221. Mike Benítez, "The best in deep sea fishing", undated promotional brochure.
222. "Marlin encounter proves fatal to mate," *The International Angler*, September-October, 1998, p. 3.
223. "The traveling fisherman," *Saltwater Sportsman*, August, 1994, p. 54.
224. Campos, *op. cit.*, February 8, 1995.
225. "110 billfish boated in Puerto Rico tourney," *The International Angler*, November, 1983, p. 7.
226. Valdes-Pizzini, "Marine recreational fisheries development ...," *op. cit.*, pp. 66-71.
227. Kimmel, *op. cit.*, May 22, 2001 and Lilyestrom, *op. cit.*, May 22, 2001.

228. For details see XIII. Government Policy.
229. Valdes-Pizzini, "Marine recreational fisheries development ...," *op. cit.*, p. 70.
230. Lilyestrom, *op. cit.*, June 18, 1999.
231. Donald J. Clark, Robert B. Ditton, and Rupero Chaparro, "La importancia economica de la pesca recreativa de aguas en Puerto Rico," internet site accessed May 10, 2001: http://lutra.tamu.edu/hdlab/execpr.htm. The multiplier used for the billfish was about 1.1. Bon Ditton explained at a meeting in Puerto Rico that it was not higher because of the close relationship between Puerto Rico and the United States. Monet spent on sport fishing for billfish in Puerto Rico is often transferred almost immediately to the mainland United States, preventing a greater multiplier effect. Lilyestrom, *op. cit.*, July 3, 2001.
232. The value of the 1999 catch was $7.6 million. NMFS, *Fisheries of the United States* (NMFS: Silver Spring, Maryland, 2000), p. 21.
233. Many economists estimate that a multiplier of two should be used to convert the value of the catch to economic impact. This multiplier is according to one NMFS economist an "accepted myth". He believes that the actual multiplier may be lower. A variety of factors are involved. One of the key factors is economic "leakages," or to what extent the inputs purchased by the fishermen are manufactured locally and the extent to which the product is sold locally. Eric Thunberg, NMFS, personal communications, May 16, 2001. In the case of Puerto Rico as the fishery is artisanal, mist of the boats are built locally and the fish marketed locally, the multiplier of two may be a realistic figure.
234. Lilyestrom, *op. cit.*, May 22, 2001.
235. For example the impact on the local economy is much greater if an angler stays at a locally owned guest house that a national or even international hotel chain. Thus economic impact studies need much more detailed information than is usually gathered or in many cases actually available. Thunberg, *op. cit.*, May 16, 2001.
236. John Ward, NMFS, personal communications, May 12, 2001.
237. See for example a newspaper article from the neighboring Dominican Republic, Alvarez Castellanos, "Impacto del turismo en boca chica hizo escasear y encarecer pescado," *Listin Diario*, October 16, 1986. p. 2D.
238. Some U.S. longline fishermen also use the USVI to land their catch (appendices A2 and D3d). The USVI, however, is outside the U.S. Customs Area which in some years has complicated shipment to the mainland United States because of the way that regulations concerning mercury standards were enforced. Landings in the Virgin Islands, however, plummeted in 1995 as a result of Hurricane Marilyn and have never recovered.
239. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
240. Mike Christian, NMFS, personal communications, January 30, 1996.
241. Christian, *op. cit.*, January 30, 1996. NMFS data confirms relatively the same level of activity (appendix A2b). Reporting was, however, voluntary until 1986 so the available data may understate actual vessel activity (appendix A2b).
242. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 617.
243. Christian, *op. cit.*, January 30, 1996.
244. Joe Martin and Bill Wood. "ABC to hit longliners," *San Juan Star*, March 27, 1987.
245. Bertolino, *op. cit.*, September 17, 2001.
246. Christian, *op. cit.*, July 28, 1987.
247. Christian, *op. cit.*, January 30, 1996.
248. Malley, *op. cit.*, February 8, 1996.
249. While Puerto Rico is within the U.S. Customs Area, the Virgin Islands are outside of it.
250. Malley, *op. cit.*, February 8, 1996.
251. J. González, *op. cit.*, January 24, 1996.
252. Nelson Beidemann, Blue Water Fishermen's Association, personal communications, June 20, 1995.
253. For details see the U.S. Virgin Islands chapter of this report.
254. Dallarosa, *op. cit.*, April 21, 1999 and February 17, 2000.
255. José Colón, Fresh Fish, personal communications, July 24, 2001.
256. Jill Stevenson, NMFS, personal communications, June 28, 2001.
257. Colón, *op. cit.*, July 24, 2001.
258. Lilyestrom, *op. cit.*, July 3, 2001.
259. J. González, *op. cit.*, January 25, 1996.
260. Malley, *op. cit.*, February 8, 1996.
261. Biedemann, *op. cit.*, June 20, 1995.
262. Malley, *op. cit.*, February 8, 1996 and Weeks, *op. cit.*, March 22, 1996.
263. Malley, *op. cit.*, February 8, 1996.

264. J. González, *op. cit.*, January 24, 1996.
265. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 617.
266. Malley, letter to the editor, *op. cit.*
267. Weeks, *op. cit.*, March 22, 1996.
268. Cramer, *Large Pelagic Logbook Newsletter*, *op. cit.*, p. 3.
269. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616 and Dallarosa, *op. cit.*, April 22, 1999.
270. Weeks, *op. cit.*, March 22, 1996.
271. Putnam MacLean reports setting ar 50-60 fathoms (90-110 m) on Georges Bank, but 200 fathoms (365 m) in the Caribbean. "Gear profiles," *National Fisherman*, March 1999, p. 43.
272. Putnam MacLean reports using, for, example, a 900 lb test line. "Gear profiles," *National Fisherman*, March 1999.
273. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
274. J. González, *op. cit.*, January 24, 1996.
275. Weeks, *op. cit.*, March 22, 1996.
276. Weeks, *op. cit.*, March 22, 1996.
277. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
278. J. González, *op. cit.*, January 25, 1996.
279. Putnam MacLean reports setting ar 50-60 fathoms (90-110 m) on Georges Bank, but 200 fathoms (365 m) in the Caribbean. "Gear profiles," *National Fisherman*, March 1999, p. 43.
280. Weeks, *op. cit.*, March 22, 1996.
281. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
282. Putnam MacLean reports setting ar 50-60 fathoms (90-110 m) on Georges Bank, but 200 fathoms (365 m) in the Caribbean. "Gear profiles," *National Fisherman*, March 1999, p. 43.
283. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
284. Putnam MacLean reports setting ar 50-60 fathoms (90-110 m) on Georges Bank, but 200 fathoms (365 m) in the Caribbean. "Gear profiles," *National Fisherman*, March 1999, p. 43.
285. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
286. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
287. J. González, *op. cit.*, January 25, 1996.
288. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
289. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
290. J. González, *op. cit.*, January 24, 1996.
291. Malley, *op. cit.*, February 8, 1996.
292. DallaRosa, *op. cit.*, April 21, 1999.
293. Weeks, *op. cit.*, March 22, 1996.
294. Weeks, *op. cit.*, March 22, 1997.
295. J. González, *op. cit.*, January 24, 1996.

SECTION VII. (Catch)

296. Stevenson, "Management of a tropical fish pot fishery ...," *op. cit.*, pp. 95-115; Boardman and Weiler, "Aspects of the life history ...," *op. cit.*, pp. 158-172; and Appeldoorn, Dennis, and Lopez, "Review of the shared ...," *op. cit.*, pp. 36-106.
297. W.R. Nelson and R.S. Appeldoorn, Cruise report, R/V Steward Johnson: A submersible survey of the continental slope of Puerto Rico and the U.S. Virgin Islands, October, 1985, 76p.
298. The authors note differences between the data reported by the LPC (appendix D2c) and NMFS (appendix D2d).
299. Matos, *op. cit.*, February 24, 1996.
300. For details see the chapter on the U.S. Virgin Islands.
301. Beginning in mid-1986, the U.S. fishermen were required to report their catch to NMFS.
302. Campos, *et.al.*, "The emergence ...," *op. cit.*, p. 616.
303. As the fishermen head and gut swordfish at sea, only the eviscerated trunks are landed. The trunk or product weight is thus less than the live-weight of the fish. Estimates of the actual live weight are included in appendix D3b.
304. For details see the U.S. Virgin Islands chapter of this report.

305. The estimate is based on Gonzales's belief that as many as 50 U.S. longliners are working out of San Juan. He reports that the fishermen average 2 trips per month during the 5 month season, or about 10 trips per season, landing 4.5-6.5 t of dressed swordfish per trip. J. González, *op. cit.*, January 24, 1996.
306. Weeks, *op. cit.*, March 22, 1996.
307. Nikki Bane, NMFS, personal communications, May 30, 2001.
308. Andy Bertolino, NMFS, personal communications, June 5, 2001 and Stevenson, *op. cit.*, June 28, 2001.
309. Bertolino, *op. cit.*, June 5, 2001.

SECTION VIII. (Ports)

310. J. González, *op. cit.*, January 24, 1996.
311. A Sea Grant project aimed at assisting artisanal fishermen deal with the ciguatera problem is currently underway at Aguadilla. Riesco, *op. cit.*, April 27, 1999. One report in the mid-1990s indicated that more artisanal fishermen operated from Cabo Rojo than any other port. Matos Caraballo, "Puerto Rican fishery census," *op. cit.*, p.3.
312. J. Gonzales, *op. cit.*, June 21, 1999.
313. Matos Caraballo and Sadovy, *Commercial Fishery Statistics*, *op. cit.*, table 9, p. 31.
314. Felíx Morales, Vice-Presidente de la Asociación de Pescadores--La Villa de Ojo, Inc., personal communications, June 24, 1999.
315. Campos, *op. cit.*, February 8, 1996.
316. Pickering, *op. cit.*, February 29, 1996.
317. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, p. 215.
318. J. González, *op. cit.*, January 25, 1996.

SECTION IX. (Transshipments)

319. Nicholson Act, 46 USC 251.
320. FDA, Import Alert, #16-08, *Regulatory Procedures Manual*, Chapter 9-25-60.
321. Mike Christian, NMFS memorandum, "Swordfish landings in the USVI," February 15, 1994.
322. "Why would I," he asks and insists that he only buys top grade product for his clients. Colón, *op. cit.*, July 24, 2001.
323. For details see the U.S. Virgin Islands chapter of this report.
324. See the Barbados chapter of this report for details.
325. For details see the Netherlands Antilles chapter of this report.
326. See the Netherlands Antilles chapter of this report for details.
327. For details see the Trinidad chapter of this report.
328. See the Trinidad chapter of this report for details.
329. See the Venezuelan chapter of this report for details.
330. Felicita Heredia L., Directora, Conservación y Costera Marina, personal communications, September 13, 2001.
331. Lilyestrom, *op. cit.*, June 18, 1999.

SECTION X. (Processing and Products)

332. Puerto Rican officials claim that the shut downs and layoffs in the fishing industry, as well as other companies in the manufacturing sector such as Intel, are due to the loss of Federal tax breaks--Section 936 of the U.S. Internal Revenue Code. This provision exempted mainland U.S. companies from paying taxes earned by their Puerto Rican manufacturing subsidiaries. An additional provision, Section 30A, provided a tax break based on the wages employers pay. Congress authorized the IRS in 1996 to beginning phasing in these changes.
333. Van Camp sold its cannery to an Indonesian Company, PT Mantrust, in 1988. INFOPESCA, "Indonesia compra de compañia enlatadora norteamericano," *Noticias Comerciales*, December 8, 1988. Bumble Bee and the former Van Camp canneries reportedly closed in 1990. "Tuna," *Seafood International*, February, 1991, p. 9. Carine, the Mitsuishi cannery in Ponce, was closed in 1995. "Cierre de planta atunera," *Boletin Informativo, SIM*," September, 1995, p. 20.
334. Casamar, "Prices still moving upwards," *Inside the Fishing Industry*, February-March, 2001: http://www.casamarintl.com/CrowsNest/2001/feb-mar01.html

335. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*
336. Juan José Díaz, Manager, Sea World Inc., personal communications, February 23, 1996.
337. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, p. 214.
338. J. González, *op. cit.*, January 25, 1996 and Malley, *op. cit.*, February 8, 1996.
339. Díaz, *op. cit.*, February 23, 1996.
340. No permit is required to handle imported tuna.
341. Malley, "Shades ...," *op. cit.*, pp. 6 and 157.
342. Tim Malley, "Shades and grades of swordfish," *Seafood Leader*, May/June 1995, pp. 6 and 157.
343. See the section on spawning and migration in chapter "II. Species".

SECTION XI. (Organizations)

344. Kimmel, *op. cit.*, May 22, 2001.
345. Cherry Sipueroa, Andy's Foods, personal communications, July 12, 2001.
346. Tony Forte, seafood dealer, personal communications, June 15, 2001.
347. José Colón, Fresh Fish, personal communications, June 13 and July 24, 2001.
348. Nicholas Zinkowski, "Caribbean longlining technology," *Catch*, February 1982, p. 9.
349. David Horton, Owner, MacLean's Seafood, undated interview by Habitat Media, internet site accessed June 8, 2001: http://www.habitatmedia.org/tran-Horton.html
350. Anna Torres, Marisquería Atlántica, personal communications, July 11, 2001.
351. Elpidio Nuñez, Northwest Select, personal communications, June 23, 2001.
352. Linda Cordero, Pescadería Atlántica, personal communications, July 11, 2001.
353. Maxímo Carretera, Pescadería Atlántica, personal communications, June 25, 2001.
354. Marta Díaz, El Pescador, personal communications, July 10, 2001.
355. Mark Cruz, Sea World, personal communications, July 11, 2001.
356. Juan José Díaz, Sea World, personal communications, June 18, 2001.
357. Díaz, *op. cit.*, February 23, 1996.
358. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 4. In a subsequent conversation Matos believes that membership has since declined somewhat. Matos Caraballo, *op. cit.*, June 18, 2001.
359. Elizar Castillo, Presidente, Congreso de Pescadores, personal communications, June 18, 2001.
360. Castillo, *op. cit.*, June 18, 2001.
361. Kimmel, *op. cit.*, May 22, 2001.
362. Matos Caraballo, "Puerto Rico fisheries census ...," *op, cit.*, p. 4.
363. Castillo, *op. cit.*, June 18, 2001.
364. Félix Morales, President, Asociación de Pescadores La Villa de Ojo, personal communications, June 15, 2001.

SECTION XII. (Markets)

365. "Nuevas tendencias en el consumo de pescado," *Boletín Marino*, Vol. 9, No. 9-10.
366. Torres, *op. cit.*, July 11, 2001.
367. Sipueroa, *op. cit.*, July 12, 2001.
368. One source indicated the local fishermen supply about 10 percent of the fish consumed in Puerto Rico. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, pp. 212-213. Another estimates that local fishermen may supply as little as 5 percent of the island's seafood consumption. Rolón, *op. cit.*, April 15, 1999 and Riesco, *op. cit.*, April 27, 1999.
369. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*
370. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p.5.
371. Pickering, *op. cit.*, February 29, 1996.
372. Colón, *op. cit.*, June 13, 2001.
373. G. García, *op. cit.*, March 13, 1996.
374. Castellanos, "Impacto del turismo ...," *op. cit.*, p. 2D.
375. Felíx Morales, Vice-Presidente de la Asociación de Pescadores--La Villa de Ojo, Inc., personal communications, August 9, 1999.
376. Matos Caraballo, *op. cit.*, April 20, 1999.
377. Rolón, *op. cit,* April 15, 1999.
378. J. Gonzalez, *op. cit.,* June 21, 1999.

379. Margarita Hutchison, "Puerto Rico: A vacation paradise," *Out in the Mountains,* February 2000.
380. G. García, *op. cit.*, May 9, 2001.
381. "The Best Restaurants," internet site accessed April 19, 2001: Http://www.frommers.com/destinations/puertorico/0094020124.html
382. DallaRosa, *op. cit.*, April 21, 199.
383. Colon, *op. cit.*, July 24, 2001.
384. Forte, *op. cit.*, June 15, 2001.
385. Díaz, *op. cit.*, February 23, 1996.
386. J. Gonzales, *op. cit.*, June 21, 1999.
387. G. García, *op. cit.*, May 9, 2001.
388. Mireya Navarro, "Puerto Rico home cooking is reborn as nueva cocina," *New York Times*, March 8, 2000.
389. One suspects that Cuba may have also had swordfish dishes, but as the species as well as basic many basic commodities have not been commonly available to island consumer for 40 years, traditional dishes have long since disappeared.
390. Robert Rosado and Judith Healy Rosado, *Recipes from La Isla* Lowell House: 1995).
391. F. Morales, *op. cit.*, June 24, 1999.
392. J. Gonzales, *op. cit.*, June 21, 1991.
393. One BVI importer, for example, reported purchasing 2 t of swordfish from Puerto Rico in 1994. Joyce Fergus, Assistant Manager, BVI Fishing Company, personal communications, January 17, 1996.
394. U.S. Bureau of the Census.
395. Colon, *op. cit.*, June 13, 2001
396. Diaz, *op. cit.*, June 18, 2001.
397. Díaz, *op. cit.*, February 23, 1996.

SECTION XIII. (Government Policy)

398. Andrew Kemmerer, NMFS Regional Director, memorandum, "Meetings with DNR personnel in Virgin Islands and Puerto Rico," October 8, 1991. Some observers are critical of how the commonwealth and Federal fisheries relationship has developed. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, pp. 216-219.
399. Ley N°82, July 7, 1979.
400. J. Gonzales, *op. cit.*, June 21, 1999.
401. 16 USC 971.
402. A good brief, but now somewhat dated review of the FCMA is available in Celia Campbell-Mohn, Barry Breen, J. William Futrell, James M. McElfish, Jr., and Paula Grant, eds., *Environmental Law: From Resources to Recovery* (West Publishing Co.: St. Paul, Minnesota, 1993), pp. 265-267.
403. G. García, *op. cit.*, May 9, 2001.
404. Nicholson Act, 46 USC 251 (b) Article VI. The Act states that fish landed by a foreign-flag vessel of appropriate length must be, "for immediate consumption *in such islands* of its catch of fresh fish, whole or with heads, viscera of fins removed, but not frozen or processed or advanced. No fish landed under this authorization shall be sold or transferred except for immediate consumption."
405. FDA, Import Alert #16-08.
406. Christian, *op. cit.*, February 15, 1994.
407. The FDA Office of Seafood Enforcement advises that prohibitions under Import Alert #16-08 can be waived under certain circumstances including petition from an affected firm, individual, or government. Details are available in FDA, "Regulatory Procedures Manual," chapter 9-25-60. Once a company or individual fishermen had four loads tested as meeting the mercury guidelines, FDA would waive mandatory inspection of every shipment.
408. See the U.S. Virgin Islands chapter of this report.
409. 50 CFR 630.
410. A U.S. report indicated a reduction of 359 tons. One ICCAT report put the reduction at 470 t live-weight. ICCAT, "Recommendation by ICCAT for the management of Atlantic swordfish," 94-14 SWO, Compendium of ICCAT Management Recommendations and Resolutions, COM-SCRS/00/10.
411. 50 CFR 630.
412. Rebecca Lent, K. Brewster-Geisz, S. Meyers, M. Schulze, and J. Stevenson, "The Sustainable Fisheries Act and Highly Migratory Species Management," presentation at the 1999 American Fisheries Society Annual Meeting, Charlotte, North Carolina, September 1, 1999.
413. Lent, *et. al.*, "The Sustainable Fisheries Act ...," *op. cit.*

414. Fred Kyle, NMFS, personal communications, May 8, 2001.
415. Clarence Pautzke, Director, Office of Sustainable Fisheries, NMFS, "NMFS seeks comments on vessel monitoring system requirements for the Atlantic pelagic longline fishery," F/SF release, January 9, 2001 and NMFS/NOAA, "Atlantic highly migratory species; pelagic longline fishery vessel monitoring system." 50 CFR Part 635, *Federal Register*, January 10, 2001, pp. 1907-1908.
416. USC Title 50 644.21.
417. Rinaldo, *op. cit.*, March 8, 1996.
418. G. García, *op. cit.*, March 13, 1996.
419. 50 CFR 285.
420. Lent, *et. al.*, "The Sustainable Fisheries Act ...," *op. cit.*
421. Lent, *et. al.*, "The sustainable fisheries Act ...," *op. cit.*
422. Ley N°83, May 13, 1936.
423. Lilyestrom, *op. cit.*, July 3, 2001.
424. PL 88-309.
425. Law 82, June 7, 1979.
426. Law 61, August 23, 1990.
427. Lilyestrom, *op. cit.*, July 3, 2001.
428. Lilyestrom, *op. cit.*, May 9, 2001.
429. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 1.
430. G. García, *op. cit.*, May 9, 2001.
431. Lilyestrom, *op. cit.*, June 4, 2001.
432. J. González, *op. cit.*, January 25, 1996. As noted above, the authors believe this estimate substantially overstates the quantity of swordfish taken by the U.S. mainland fishermen.
433. Rolón, *op. cit.*, June 10, 1999.
434. Lilyestrom, *op. cit.*, May 22, 2001.
435. J. Gonzales, *op. cit.*, June 21, 1999.
436. Reglamento para la administración de la pesca de pez espada, December 3, 1987 and Craig Lilyestrom, Chief, Marine Resources, Department of Natural and Environmental Resources, Commonwealth of Puerto Rico, personal communications, June 18, 1999.
437. Presidential Proclamation No. 5928, December 27, 1988.
438. The jurisdictional waters of Florida (west coast) and the Commonwealth of Puerto Rico, which entered the Union as Spanish possessions and thus under Spanish law, is different than the other states. For the same reason Texas, which entered as an independent country, is different.
439. Dallarosa, *op. cit.*, June 4, 1999. This is different from most states because of the legal regime of Spain in force when Puerto Rico was acquired by the United States in 1899.
440. Presidential Proclamation No. 5030, March 10, 1983. The proclamation was applicable to all U.S. territories and possessions.
441. U.S. Department of State, *Limits in the Seas*, No. 91.
442. See for example, U.S. Department of State, "United States-United Kingdom maritime boundaries in the Caribbean," *Limits in the Seas*, No. 115, April 11, 1994.
443. Lilyestrom, *op. cit.*, June 18, 1999.
444. Meyers, *op. cit.*, June 13, 2001.
445. For details on Puerto Rican fisheries promotion programs see CODREMAR, "Desarrollo de la pesca commercial marina en Puerto Rico," *Guia del Pescador*, No. 6, April, 1987, pp. 9-14.
446. Programa Federal\Estatal de Investigación y Desarrollo Pesquero, Ley N°88-309, 1966 implementing the Commercial Fishery Research and Development Act of 1964.
447. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, p. 214.
448. CODREMAR, "Dipositivos para atraer peces," *Guia Pescador* (CODREMAR: San Juan, 1988), 15p.
449. Matos Caraballo, "Puerto Rico fishery census," *op. cit.*, p. 5.
450. Lilyestrom, *op. cit.*, June 18, 1999.
451. J. Gonzales, *op. cit.*, June 21, 1999.
452. Kimmel and Appeldoorn, "A critical review ...," *op. cit.*, pp. 214-215.
453. "Posibilidad de entrenamiento ofrecido por Puerto Rico a pescadores artesanales de la región," *AP-CC*, May, 1991, p. 3.

454. Dorado along with flyingfish are species on which Caribbean researchers have focused. Researchers on Barbados have been especially active. See for example Hazel A. Oxenford and Wayne Hunte, "A preliminary investigation of the stock structure of the dolphin, *Coryphaena hippurus*, in the western central Atlantic, *Fisheries Bulletin*, Vol. 84, no. 2, 1986, pp. 451-460 and Hazel A. Oxenford and Wayne Hunte, "Migration of the dolphin *(Coryphaena hippurus)* and its implication for fisheries management in the Western Central Atlantic," *Gulf and Caribbean Fisheries Institute Proceedings, 1984*, 1986 Vol. 37, pp. 95-111.
455. The research on these and other pelagics are summarized in Appeldoorn and Meyers, "Puerto Rico and Hispaniola," *op. cit.*, pp. 132-139. Much of the information comes from CFMC, "Fishery management plan and environmental ...," *op. cit.* One of the Puerto Rican researchers that was particularly active was D.S. Erdman who worked with the Puerto Rican Department of Agriculture.
456. Ojeda, *op. cit.,* April 23, 2001.
457. The CFMC has prepared plans for spiny lobster (1985), reef fish (1985), and corals (1995). A plan for queen conch is currently being prepared. NMFS has prepared FMPs for three other fisheries involving the Atlantic coast, including Puerto Rico and the USVI: swordfish (1985), billfish (1988), and sharks (1993).
458. Caribbean Fisheries Management Council, "Highlights," December, 1984.
459. G. García, *op. cit.*, March 13, 1996.
460. Martin and Wood, "ABC to hit longliners," *op. cit.*
461. Rolf Juhl, "A report on the exploratory fishing and gear tests in Puerto Rico from 1969 to 1972," *Contribuciones Agropecuarias y Pesqueras*, Vol. IV, No. 3 (Departamento de Agricultura: Cabo Rojo, November, 1972), 63p.
462. Robyn S. Wingrove, "Stock structure of the dolphin, *Coryphaena hippurus*, in the western central Atlantic as determined by RFLP analysis," paper delivered at the 1999 American Fisheries Society Annual Meeting, Charlotte, North Carolina, September 1, 1999.
463. Juhl, "Exploratory fishing ...," *op. cit.*
464. The research was led by Miguel Figuera. Matos, *op. cit.*, May 10, 2001.
465. Pérez and Sadovy, "Preliminary data ..., " *op. cit.*, pp. 651-670.
466. Yvonne Sadovy, "History, current activities, goals and perspectives: Puerto Rico Department of Natural Resources," in Brown, Erb, and Maul, *Intra-Americas Sea Marine Science Meeting of U.S. Experts*, (NMFS: Miami, July, 1992), pp. 61-62.
467. Matos Caraballo, *op. cit.*, February 24, 1996.
468. Formerly NMFS/NOAA was the Bureau of Commercial Fisheries (BCF) in the Interior Department. Thus U.S. research before NOAA was created in 1970 was conducted through BCF in the Interior Department.
469. Caribbean Fisheries Management Council, *Council Memo*, October, 1982.
470. Kawaguchi, "Exploratory tuna longline fishing ...," *op. cit.*, p. 62.
471. Zinkowski, "Caribbean longlining technique," *op. cit.*, p. 9-10.
472. Campos, *et. al.*, "The emergence ...," *op. cit.*, p. 615 and NMFS/NOAA, Cruise No. 132, January 12-17, 1983.
473. G.M. Russell, E.J. Gutherz, and C.A. Barans, "Evaluation of demersal longline gear off South Carolina and Puerto Rico with emphasis on deep-water reef fish stocks," *Marine Fisheries Review*, vol. 50, no. 1, 1988, pp. 26-31.
474. D. Feigenbaum, C. Blair, A. Friedlander, and M. Bushing, "The feasibility of using fish aggregating devices (FADs) off Puerto Rico," *Gulf and Caribbean Fisheries Institute Proceedings* vol. 39 (GCFI: Miami, Florida, 1989), pp. 218-229.
475. D. Feigenbaum, M. Bushing, and J. Strickland, "Evaluation of mooring line resistance to shark bite," *Gulf and Caribbean Fisheries Institute Proceedings*, vol. 41 (GCFI: Charleston, S.C., 1992), pp. 595-599.
476. Manuel Hernandez-Avila, Jorge E. Corredor, and Julio M. Morrell, "University of Puerto Rico," in Brown, Erb, and Maul, *Intra-Americas Sea Marine Science Meeting of U.S. Experts*, (NMFS: Miami, July, 1992), p. 100.
477. Valdes-Pizzini, "Marine recreational fisheries ...," *op. cit.*
478. Kurt Grove, Sea Grant Research Coordinator, University of Puerto Rico, personal communications, May 4, 1999 and Riesco, *op. cit.*, April 27, 1999.
479. Valdes-Pizzini, "Marine recreational fisheries development ...," *op. cit.*, pp. 66-71.
480. Ojeda, *op. cit.*, April 23, 2001.
481. Hernandez-Avila, *et. al.*, "University of Puerto Rico," *op. cit.*, pp. 100-102.

482. Campos, *et.al.*, "The emergence ...," *op. cit.*, pp. 615-616.
483. Rivera and Appeldoorn, "Age and growth ...," *op. cit.*, pp. 345-352.
484. Armstrong, *op. cit.*, May 16, 2001.
485. G. García, *op. cit.*, May 9, 2001.

SECTION XV. (Bycatch)

486. Asian longline countries and Spain have not reported in detail on the species composition of their substantial Atlantic longline operations. One exception is the reporting required of the Japanese when operating in U.S. and Canadian waters. NMFS personnel working on sharks, however, have noted a few preliminary papers in recent years with some shark species data. There may be data on other bycatch species as well. John Hoey, NMFS, personal communications, August 3, 2001. An example of one of these papers is Valentín Buencuerpo, Santiago Ríos, and Julio Morón, Pelagic sharks associated with the swordfish, *Xiphias gladius*, fishery in the North Atlantic Ocean and the Strait of Gibraltar," *Fisheries Bulletin*, 1998, Vol. 96, pp. 667-685.
487. Cramer, "Large pelagic logbook newsletter - 1994," *op. cit.*, pp. 29-33.
488. G. García, *op. cit.*, May 9, 2001. See "XII. Markets" for details on the Puerto Rican seafood market.
489. USC Title 50 644.21. Puerto Rican officials are particularly concerned about marlin stocks and the potential impact on the island's important recreational fishing industry. Since the longliners have begun operating off Puerto Rico, the marlin catch rate has reportedly declined. González, *op. cit.*, January 24, 1996.
490. ICCAT, *Report on the Standing Committee on Research and Statistics*, COM/95/25, *op. cit.* See especially p. 50, p. 55, and p. 60.
491. Kimmel. *op. cit.*, May 22, 2001 and Lilyestrom, *op. cit.*, May 22, 2001.
492. NMFS in 2001 is drafting regulations to implement this new law.
493. J. González, *op. cit.*, January 25, 1996.
494. 50 CFR Part 635
495. Cramer, "Large pelagic logbook newsletter - 1994," *op. cit.*, p. 32.
496. 50 CFR 635. NMFS, "Atlantic highly migratory species; pelagic longline fishery; sea turtle protection; shark drift gillnet fishery," interim final rule; request for comments, March 29, 2001, *Federal Register*, March 30, 2001, pp. 17370-17373 and NMFS, "Environmental assessment and regulatory impact review for an emergency rule to reduce sea turtle bycatch and bycatch mortality in the Atlantic pelagic longline fishery," July 5, 2001.
497. 65 FR 60889. 50 CFR 635: NMFS, "Atlantic highly migratory species; pelagic longline fishery; sea turtle protection measures," emergency rule request for comments, July 10, 2001, *Federal Register*, July 13, 2001, pp. 36711-36714
498. Colón, *op. cit.*, June 13, 2001.
499. Matos Caraballo, *op. cit.*, June 18, 2001.
500. F. Morales, *op. cit.*, June 24, 1999.
501. This activity requires prolonged and geographically scattered enforcement efforts due to the number and location of the fishing clubs. Santos Gonzalez, NMFS Special Agent, NMFS memorandum, October 9, 2001.
502. Recreational fisherman interviewed October 5, 2001 at the Club Deportivo de Mayagüez, S. Gonzalez, *op. cit.*, October 9, 2001.
503. Jean Cramer, "Estimates of the numbers and metric tons of sharks discarded dead by pelagic longline vessels," *ICCAT collected Volume of Scientific Papers*, (SCRS/96/158), Vol. 26, No. 4 (ICCAT: Madrid, 1997), pp. 438-440.
504. Cuba had an extensive shark fishery and virtually wiped out nurse sharks along the Cuban coast. For details see the Cuban chapter of this report. Nurse sharks populations have also been disseminated by U.S. fishermen off Florida.
505. Lilyestrom, *op. cit.*, May 22, 2001.
506. Dorado is most commonly referred to as "dolphin" or "dolphinfish" in the English-speaking Caribbean. The authors have chosen to refer to the species as "dorado" which is more common in Spanish-speaking countries. We have done so as we have used "dorado" in our already published swordfish reports on the South American countries.
507. Oxenford and Hunte, "A preliminary investigation ...," *op. cit.*, pp. 451-460.
508. Wingrove, "Stock structure ...," *op. cit.*
509. Oxenford and Hunte, "Migration of the dolphin ...," *op. cit.*, pp. 510-527.
510. Rivera and Appeldoorn, "Age and growth ...," *op. cit.*, pp. 345-352.
511. Pérez and Sadovy, "Preliminary data ..., " *op. cit.*, pp. 653-654.

512. The authors know of no study of lacetfish in the wider-Caribbean, but some work has been done on the species in other areas. E.V. Romanov and V.V. Zamorov, "Some biological features of longnose lancetfish *Alepisaurus ferox* (Alepisauridae) from the Western Indian Ocean," in L. Coetzee, J. Gon, and C. Kulongowski (eds.) *African Fishes and Fisheries Diversity and Utilization (Grahamstown, South Africa: FISA/PARADI, 1998)*, p. 326.
513. Zandy-Marie Hillis-Starr, Ralf Boulon, and Michael Evans, "Sea turtles of the Virgin Islands and Puerto Rico," internet site accessed April 19, 2001: http://biology.usgs.gov/s+t/SNT/noframe/cr136.htm
514. Héctor Horta, Puerto Rican Departamento de Recursos Naturales y Ambientales, personal communications, July 17, 2001.
515. Hillis-Starr, Boulon, and Evans, "Sea turtles of the Virgin Islands and Puerto Rico," *op. cit.*
516. A.D. Tucker, "Revised estimate of annual reproductive capacity for leatherback sea turtles (*Dermochelys coriacea*) based on interseasonal clutch frequency," in the Second Western Atlantic Turtle Symposium Proceedings, *NOAA Technical Memo* NOAA-TM-NMFS--SEFC226, 1989, pp. 345-346.
517. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
518. Horta, *op. cit.*, July 17, 2001.
519. J.A. Collazo, R. Boulon, Jr., and T.L. Tallevast, "Abundance and growth patterns of *Chelonia mydas* in Cúlebra, Puerto Rico," *Journal of Herpetology*, vol. 26, no. 3, 1992, pp. 293-300.
520. Anna L. Bass, "Genetic analysis to elucidate the natura history and behavior of hawksbill turtles (*Eretmochelys imbricata*) in the wider Caribbean: a review and re-analysis," *Chelonia Conservation and Biology*, Vol. 3, No. 2, 1999, pp. 195-199.
521. R.P. van Dam, and C.E. Diez, "Preliminary evaluation of plastic tag performance on Caribbean hawksbill turtles," *Marine Turtle Newsletter*, n. 76, January 1997, pp. 11-12.
522. Bass, "Genetic analysis ...," *op. cit.*, p. 197.
523. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
524. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
525. Horta, *op. cit.*, July 17, 2001.
526. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
527. Interestingly, some annual reports indicate that the Puerto Rican catch was all taken by spears and by hand (diving) while other years note gillnets accounted for the entire catch. NMFS, *Fishery Statistics of the United States*, 1971-76. NMFS used published Puerto Rican sources for the data.
528. W.N. Witzell, "The origin, evolution, and demise of the U.S. sea turtle fisheries," *Marine Fisheries Review*, vol. 56, no. 4, 1994, pp. 9, 17, and 21.
529. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
530. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
531. Many Caribbean countries fully protect turtles. A moratorium is in place, for example, on nearby Anguilla, although the fishermen would like to see it removed. Other islands permit varying levels of turtle takes. The nearby British Virgin Islands is of particular concern. Some islands have banned the taking of turtles and then rescinded it, such as St. Lucia which is also close to Puerto Rico. Chris Boyle, "St. Lucia hunts turtles again," 2000 internet posting: http://www.turtlereef.net/linksandcorpages/xhrisdyturts.htm. The largest take of turtles in the Caribbean is reported by Cuba. Although Cuba has substantially reduced its turtle catch in recent years, it has waged a major diplomatic effort to gain acceptance for a plan to renew hawksbill shell exports to Japan. Available details on turtle regulations and catch levels, if any, are included in the individual island chapters of this report.
532. Horta, *op. cit.*, July 17, 2001.
533. Acosta, "A preliminary study ...," *op. cit.*, pp. 185-186.
534. Colón, *op. cit.*, July 24, 2001.
535. Hillis-Starr, Boulon, and Evans, "Sea turtles ...," *op. cit.*
536. Daniel T. O'Brien, NMFS Enforcement Office, personal communications, June 23, 2001.
537. The NMFS estimates are based on partial observer data adjusted by effort. Actual observer reports of interactions are available (Caribbean Overview, appendix G1b2).
538. "Puerto Rico threatens to sue U.S. Navy, Associated Press, August 9, 1999.
539. P.T. Stevick, C.A. Carlson, and K.C. Balcomb, "A note on migratory destinations of humpback whales from the eastern Caribbean," *Journal of Cetacean Research and Management*, Vol. 1, no. 3, December 1999, pp. 251-254.
540. D.K. Mattila and P.J. Clapham, "Humpback whales, *Megaptera novaeangliae*, and other cetaceans on Virgin Bank and in the northern Leeward Islands, 1985 and 1986," *Canadian Journal of Zoology*, vol. 67, no. 9, 1989, pp. 2201-2211.

541. D.K. Mellinger, C.D. Carson, and C.W Clark, "Characteristics of minke whale (*Balaenoptera acutorostrata*) pulse trains recorded near Puerto Rico," *Marine Mammal Science*, Vol. 16, no. 4, October 2000, pp. 739-756 and E.D. Mitchell, "Winter records of the minke whale (*Balaenoptera acutorostrata acutorostrata* Lacepede 1804) in the southern North Atlantic," *Rep. Int. Whaling Commission* IWC SC/42/NHMi36, vol. 41, 1991, pp. 455-457.
542. A.A. Mignucci-Giannonni, M.A. Rodriguez Lopez, J.J. Perez Zayas, R.A. Montoya Ospina, and E.H. Williams, Jr., "First record of the melonhead whale (*Peponocephala electra*) for Puerto Rico," *Mammalia*, vol. 62, no. 3, 1998, pp. 452-457.
543. A.A. Mignucci, B. Pinto-Rodriguez, M. Velasco-Escudero, R.A. Montoya-Ospina, N.M. Jimenez-Marrero, M.A. Rodriguez-Lopez. E.H. Williams Jr., and D.K. Odell, "Cetacean strandings in Puerto Rico and the Virgin Islands," *Journal of Cetacean Research and Management*, Vol. 1, no. 2, September 1999, pp. 191-198.
544. Dennis Lee, Observer Program Director, NMFS, Southeast Fisheries Science Center, personal communications, June 15, 2001.
545. Ruud van Halewyn and Robert L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), "Status and conservation of the world's seabirds," *ICBP Technical Publication*, No. 2 (ICBP: Cambridge, 1984), p 175.
546. D.A. Shealer, T. Floyd, and J. Burger, "Host choice and success of gulls and terns kleptopatasitizing brown pelicans," *Animal Behavior,* vol. 53, no. 3, March 1997, pp. 655-665 and J. Burger and M. Gochfeld, "Lead, mercury, and cadmium in feathers of tropical terns in Puerto Rico and Australia," *Archives of Environmental Contamination and Toxicology*, vol. 21, no. 2, 1991, pp. 311-315.
547. Burger and Gochfeld, "Lead, mercury, and cadmium ...," *op. cit.*, pp. 311-315.
548. The convention for fish species is to not capitalize species common names such as swordfish or yellowfin tuna. The convention among ornithologists, however, is to capitalize the common names such as Brown Noddies. Thus the common names of fish and seabirds are handled differently in this report.
549. M.E. Baltz, M.J. Burke, and P.J. Davidson, "New records of Audubon's shearwater (*Puffinus lherminieri*) breeding colonies in the Exuma Cays," *Bahamas Journal of Science*, Vol. 6, no. 1, November 1998, pp. 43-46.
550. David Wingate, personal communications, in R. Van Halewyn and R.L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), Status and Conservation of the World's Seabirds," *ICBP Technical Publication*, No. 2, 1984, pp. 169-222.
551. B.C. Panuska, J.M. Mylroie, D. Armentrout, and D. McFarlane, "Magnetostratigraphy of Cueva del Alemán, Isla de Mona, Puerto Rico and the species duration of Audubon's sherwater," *Journal of Cave and Karst Studies*, Vol. 60, no. 2, August 1998, pp. 96-100.
552. D.A. Shealer, "Differences in diet and chick provisioning between adult roseate and sandwich terns in Puerto Rico," *Condor*, vol. 100, no. 1, February 1998, pp. 131-140.
553. D.A. Shealer and J. Burger, "Differential responses of tropical roseate terns to aerial intruders throughout the nesting cycle," *Condor*, Vol. 94, no. 3, 1992, pp. 712-719 and J. Burger and M. Gochfeld, "Nest-site selection by roseate terns in two tropical colonies on Cúlebra, Puerto Rico," *Condor*, vol. 90, no. 4, 1988, pp. 843-851.
554. D.A. Shealer, "Foraging habitat use and profitability in tropical roseate and sandwich terns," *Auk*, vol. 113, no. 1, 1996, pp. 209-217.
555. D.A. Shealer and J. Burger, "Comparative foraging success between adult and one-year old roseate and sandwich terns," *Colonial Waterbirds*, vol. 18, no. 1, 1995, pp. 93-99.
556. R.D. Morris and J.W. Chardine, "Brown noddies on Cayo Noroeste, Cúlebra, Puerto Rico: What happened in 1990?" *Auk*, vol. 112, no. 2, 1995, pp. 326-334.
557. John W. Chardine, Canadian Wildlife Service, personal communications, July 11, 2001.
558. John Chardine, Canadian Wildlife Service, personal communications, May 4, 2001.
559. Lisa Ballance, NMFS, personal communications, May 4, 2001; Kim Riverra, NMFS, personal communications, April 27, 2001, and Chardine, *op. cit.*, May 4, 2001.
560. Van Halewyn and Norton, "The status ...," *op. cit.*, pp. 175 and 211-212.
561. Lee, *op. cit.*, June 15, 2001.
562. Ballance, *op. cit.*, May 4, 2001.
563. Rivera, *op. cit.*, April 27, 2001 and Ballance, *op. cit.* June 26, 2001.

SECTION XVI. (International)

564. NOAA prepares an annual report on the proceedings at the ICCAT meetings which includes details on discussions and decisions taken concerning swordfish and other ocean pelagics. See Will Martin, Chairman, U.S. Delegation, *Report of the United States Delegation to Ninth Special Meeting of the International Commission for the*

Conservation of Atlantic Tunas (NOAA: Washington, D.C., February 1995).
565. ICCAT statistical squares are 5° blocks denominated by the intersection of latitude and longitude at the southeastern corner. Thus ICCAT 2065 square is the 5° ocean area bounded by 20° and 25°N and 65° and 70°W.
566. Kemmerer, "Meetings with DNR personnel in Virgin Islands and Puerto Rico," *op. cit.*
567. U.S. Department of State, "United States-United Kingdom maritime boundaries in the Caribbean," *Limits in the Seas*, No. 115, April 11, 1994.
568. G. García, *op. cit.*, May 9, 2001.
569. Cuba has conducted operation in the Gulf of Mexico and Caribbean off of Mexico, in The Gulf of Mexico off the United States and along its northern coast off the Bahamas. For details on the Cuban longline fishery see the Cuban chapter of this study.
570. "Intentará Puerto Rico llegar a un acuerdo con República Dominicana sobre la jurisdicción marítima," *Diario las Americas*, December 23, 1978 and "Propondrá Puerto Rico negociaciones conjuntas a la República Dominicana, *Diario las Americas*, February 16, 1979. A good, but now some what dated survey of Dominican Republic-Puerto Rican fishery relations is available in José A. Suárez Caabro, *Informe Sobre la Pesca en la Republica Dominicana y sus Relaciones con Puerto Rico* (Laboratorio de Pesquería Commercial: Puerto Rico, September, 1977).
571. CFMC, "U.S.-Dominican Republic fishery and maritime boundary agreement," *Council Memorandum*, November, 1982.
572. Larry Snead, Director, Office of Fisheries Affairs, letter to Steven Monsanto, Chairman, Caribbean Fisheries Management Council, September 21, 1990.
573. Snead, letter to Steven Monsanto, *op. cit.*
574. Most of the eastern Caribbean islands have a harmonized fisheries law promoted by the Organization of Eastern Caribbean States (OECS). The Netherlands Antilles, however, is not an OECS member.
575. "Estudian Españoles la posibilidad de abrir fábricas en Puerto Rico," *Diario las Americas*, October 28, 1978, p. 3.
576. Dennis Weidner, NMFS memorandum, "Puerto Rican-Spanish fisheries cooperation," October 31, 1978.
577. Orlando Rosa, Resident Agent, letter to Brat Michael, NMFS, March 17, 2001.
578. Orlando Rosa, Resident Agent, personal communications, May 22, 2001.
579. For details see the Peruvian and Chilean chapters of this report.
580. See the Bermuda chapter of this report for more details.
581. For details on St. Maarten, see the Netherlands Antilles chapter of this report.
582. For details see the Trinidadian chapter of this report.
583. U.S. Embassy, Nassau, message number 6098, November 15, 1990.
584. Graciela Garcia Moliner, Biologist, Caribbean Fisheries Management Council, personal communications, March 27, 2000.
585. Deborah Ramirez, "RHC off to D.R., Costa Rica to stir 936 report," *San Juan Star*, Sept. 12, 1985, p. 14 and Deborah Ramirez, "D.R., R.R. sign agreement for tuna twin-plant," *San Juan Star*, Sept. 14, 1985, p. 2.

SECTION XVII (Enforcement)

586. Billfish was added as an amendment.
587. S. González, *op. cit.*, October 9, 2001.
588. Daniel T. O'Brien, NMFS Enforcement Office, personal communications, June 23, 2001.
589. S. González, *op. cit.*, October 9, 2001.
590. O'Brien, *op. cit.*, June 23, 2001.
591. Pickering, *op. cit.*, February 29, 1996.
592. Dale Jones, "Notice of enforcement action," NMFS/NOAA, August 2, 1999.
593. U.S. Embassy, Nassau, "Puerto Rican fishing vessel seized by Bahamians," message number 4032, November 17, 1993.
594. "Detienen a pesquero que transportaba una tonelada de cocaína cerca de Santa Cruz," *Diario las Americas*, May 12, 1987.
595. "Liberan a pescadores Puertorriqueños," *Diario las Americas*, July 30, 1978.
596. "Existe un conflicto pesquero entre Puerto Rico y República Dominicana," *Diario las Americas*, April 15, 1978.
597. Dennis Weidner, NMFS memorandum, "Seizure of Spanish vessel off Puerto Rico," April 14, 1978.
598. Jones, *op. cit.*, August 2, 1999.
599. Dallarosa, *op. cit.*, February 17, 2000.

APPENDICES

Series A: Vessels
Series B: Research
Series C: Fishermen and gear
Series D: Catch
Series E: Consumption and marketing
Series F: Trade
Series G: Bycatch
Series H: Glossaries

Appendix A1.--Puerto Rico. Fishing fleet, 1978

Length		Coast				Total	Proportion
		North	South	East	West		
Feet	Meters	Number					Percent
4-6		-	-	-	-	-	-
7-9		-	-	-	-	-	-
10-12		8	-	6	3	17	1.6
13-15		24	37	31	71	163	15.2
16-18		144	227	61	247	679	63.3
19-21		26	26	31	30	113	10.5
22-24		6	8	21	4	39	3.6
25-27		1	-	3	3	7	0.7
28-30		2	5	2	12	21	2.0
31-33		-	1	2	1	4	0.4
34-36		1	2	2	3	8	0.8
36>		-	6	1	15	22	2.1
Total		212	312	160	389	1,073	100.0

Note: More recent estimates on the fleet suggest that about 1,000-1,500 boats were active in 1995.
Source: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 14.

Appendix A2a.--Puerto Rico/U.S. Virgin Islands. Active longline vessels, 1980-94

Season	Mainland*		Total	Local		Total	Grand total
	PR	USVI		PR	USVI		
			Number				
1980-81	-	-	-	-	-	-	-
1981-82	-	-	-	-	-	-	-
1982-83**	-	-	-	-	-	-	-
1983-84	NA	NA	2	-	-	-	2
1984-85	NA	NA	13-15E	-	-	-	13-15E
1985-86	NA	NA	35E	-	-	-	35E
1986-87	NA	NA	NA	-	1	1	
1987-88	NA	NA	70E	-	1	1	70E
1988-89	NA	NA	NA	-	1	1	
1989-90	17	NA	NA	-	1	1	
1990-91	14	NA	20	-	1	1	20E
1991-92	22	6	28	-	1	1	28
1992-93	17			-	1	1	
1993-94	21			-	1	1	
1994-95	33	6	39	-	1	1	40
1995-96	29	NA	NA/P	-	1	1	NA
1996-97	26						
1997-98	14						
1998-99	9			-			
1999-00				-			
2000-01	4E			-			

* Longliners based in U.S. mainland ports and seasonally deployed off Puerto Rico and the U.S. Virgin Islands, landing their catch in either Puerto Rico (San Juan) or the U.S. Virgin Islands (St. Croix or St. Thomas).
** NMFS and the University of Puerto Rico conducted test fishing, including longlines.
E - NMFS Estimate
P - Projection. Several longliners were destroyed in Hurricane Marilyn in 1995. Several other fishermen are reportedly selling their vessels. It is possible that only about 10 mainland longliners will be deployed during 1996.
Source: Mike Christian, NMFS, personal communications, January 30, 1996, Dallarosa, *op. cit.*, April 21, 1999 and February 17, 2000; and Angelo Bertolino, Southeast Fisheries Science Center, computer printout, June 14, 2001.

Appendix A2b.--Puerto Rico. Longliners operating out of San Juan, 1990-99

Year	Vessels	Trips	Activity
	Number		Trips/Vessel
1984*	3	3	1.0
1985*	16	56	3.5
1986*	37	192	5.2
1987	32	158	4.9
1988	25	86	3.4
1989	21	44	2.1
1990	17	39	2.3
1991	14	46	3.3
1992	22	57	2.6
1993	17	37	2.2
1994	21	70	3.3
1995	33	96	2.9
1996	29	138	4.8
1997	26	101	3.9
1998	14	50	3.6
1999	9	27	3.0
2000	5	17	3.4

* First U.S. longline catches reported for the Caribbean region during December 1984. The United States instituted mandatory reporting of fishing locations during mid-1986. Data was previously (1984-86) compiled from voluntary reporting of fishing locations and may not as accurately reflect first port of landings totals available in more recent years (1987-2000).
Source: Angelo Bertolino, Southeast Fisheries Science Center, computer printout, June 14, 2001.

Appendix A3.--U.S. Virgin Islands/Puerto Rico. Swordfish vessel permits*, 1984-96

Year/ Vessel	Owner	Port
1984		
Tiburón	Richard Wood	USVI: Cove Bay
Fay	Albert Slaughter	PR: San Juan
1985		
Fay	Albert Slaughter	PR: San Juan
1986		
1987		
Gemini	McAuliffe Fishing Inc.	USVI: Christiansted
Fay	Albert Slaughter	PR: San Juan
Tiburón	James Dalmida	USVI: St. John
White Seal	Christian Johnson	PR: San Juan
1988		
Gemini	McAuliffe Fishing Inc.	USVI: Christiansted
Tiburón	James Dalmida	USVI: St. John
1989		
Gemini	McAuliffe Fishing Inc.	USVI: Christiansted
Tiburón	James Dalmida	USVI: St. John
1990		
Gemini	McAuliffe Fishing Inc.	USVI: Christiansted
Tiburón	James Dalmida	USVI: St. John
GG	Rick Steiner/Chris Seiler	USVI: St. Thomas
Real World	Colin Tyrell	USVI: St. Thomas
1991		
Tiburón	James Dalmida	USVI: St. John
Sweet Sherrie	McAuliffe Fishing Inc.	USVI: St. Croix
1992		
Sweet Sherrie	McAuliffe Fishing Inc.	USVI: St. Croix
Sword Master	James Kreglo	USVI: St. Thomas
Tiburón	James Dalmida	USVI: St. John
Sweet Sherrie	McAuliffe Fishing Inc.	USVI: St. Croix
1993		
Sword Master	James Kreglo	USVI: St. Thomas
Tiburón	James Dalmida	USVI: St. John
Johnny C	Donna McNamara/Bruce Putnam	USVI: St. Thomas
1994		
Sweet Sherrie	McAuliffe Fishing Inc.	USVI: St. Croix
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Tiburón	James Dalmida	USVI: St. John
1995		
Sweet Sherrie	McAuliffe Fishing Inc.	USVI: St. Croix
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Tiburón	James Dalmida	USVI: St. John
1996		
First Coast I	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Sweet Sherrie	McAuliffe/David Robinson	USVI: Christiansted, St. Croix/St. Thomas
Tiburón	James Dalmida	USVI: St. John
1997		
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Sweet Sherrie	David Robinson	USVI: St. Thomas
1998		
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Tiburón	James Dalmida	USVI: St. John

1999		
First Coast I	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Tiburón	James Dalmida	USVI: St. John
2000		
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix
Tiburón	James Dalmida	USVI: St. John
2001		
Stormin Norman	McAuliffe Fishing Inc.	USVI: Christiansted, St. Croix

* Issued for vessels homeported in the U.S. Virgin Islands or Puerto Rico.
Source: Southeast Region (F/SER), NMFS.

Appendix A4.--Puerto Rico. U.S. longliners operating out of San Juan, 1998-99

Vessel
Deesie
Destiny
Eagle Eye
Eagle Eye II
Eyelander
Seahawk
Others*

* Five other U.S. longliners were active.
Source: Mike Dallarosa, NMFS, personal communications, February 17, 2000 and Andy Bertolino, NMFS, personal communications, May 7, 2000.

Appendix A5.--Puerto Rico. Tuna fishing permits, 2001

Jurisdiction and permit type/Vessel name	Size: Capacity GRT	Size: Length Meters	Hull	Port: Home	Port: Operating
Longline*					
Charter/headboat					
Driftwood	23	13	Wood	Puerto Real	Cabo Rojo
Grand Illusion	11	10	GRP	San Juan	Same
Karolette	39	14	GRP	Humacao	Same
Katamandu	4	10	Other	Rincón	Same
(The) Legend	32	15	GRP	San Juan	Same
Militza	8	9	GRP	Rincón	Same
Mr. Fisherman	8	9	GRP	San Juan	Same
Nerus	6	9	GRP	San Juan	Same
Harpoon					
Guama	1	5	GRP	Aguadilla	Same
Marisabel	1	5	Other	Aguada	Same
Vannessa	1	5	Other	Aguada	Same
General**					
"Up Yours"	1	6	GRP	Rincón	Same
Adimary	1	6	Wood	Rincón	Same
Aguada 0001	1	6	GRP	Aguada	Same
Albanely	1	4	Wood	Aguadilla	Same
(El) Alba	1	5	GRP	Aguada	Same
Aly	1	6	Other	Aguadilla	Same
Angel	1	6	GRP	Rincón	Marina Rincón
Angelina	1	5	Other	Aguada	Same
Atria	1	5	Wood	Aguada	Same
Bel Maris	1	5	Other	Aguada	Same
Berta		5	Other	Aguadilla	Same
Blanca	1	4	GRP	Aguada	Same
Brenda	1	5	GRP	Aguada	Same
Caliche	1	6	GRP	San Juan	Same
Carmen	1	5	Wood	Aguadilla	Same
Carmen Ana	1	5	GRP	Aguadilla	Same
(La) Casona	1	4	Wood	Aguada	Aguada
Celis	1	5	Wood	Aguada	Same
Chopa	4	8	GRP	Fajardo	Same
Colsa Rio	1	6	GRP	Cibuco	Same
(El) Costanero	1	5	GRP	Puerto Palmas	Same
Coyote	1	7	GRP	Rincón	Same
Cuca	1	5	Wood	Aguadilla	Same
Cynthia	1	5	Wood	Aguada	Same
Daisy	1	5	GRP	Aguadilla	Same
Daisy Maíz	13	10	GRP	San Juan	Same
Dennice	1	5	GRP	Aguadilla	Same
Edna	1	5	Wood	Aguadilla	Same
Elanie	1	5	GRP	Aguadilla	Same
Elizabeth	1	5	GRP	Aguadilla	Same
Elizabeth	1	5	GRP	Aguadilla	Same
Estrella de Venos	1	5	FRP	Aguadilla	Same
Evelyn	2	5	Wood	Aguada	Same
Explorer	1	5	Other	Aguadilla	Same
Falymara	1	5	Wood	Aguadilla	Same
Gary	1	5	GRP	Fajardo	Same
HetyB	2	7	GRP	Puerto Palmas	Same
Hilda	1	5	GRP	Aguadilla	Same
Hydrophilic	1	4	GRP	Puerto Palmas	Same
Isabel	1	5	Wood	Aguadilla	Same
Jahzeel	1	5	GRP	Tres Hermanos, Anasco	Same
Janice	1	5	Wood	Aguadilla	Same
Jannette	1	5	Other	Aguadilla	Same
Jessica	1	5	GRP	Pinones	Same
Jiol	1	5	Other	Aguadilla	Same
Johana	1	5	GRP	Aguada	Same
Jose Luis	1	5	Other	Aguadilla	Same
Josie	1	5	Wood	Sector Playuela	Same
Keisha	1	5	Wood	Aguadilla	Same
Keychla	1	5	Other	Aguadilla	Same

Libertad	1	5	GRP	Aguadilla	Same
Linda	1	5	GRP	Aguadilla	Same
Luz	1	5	Other	Aguadilla	Same
Magaly	1	6	GRP	Rincón	Same
Mara	1	5	Wood	Sector Playuela	Aguadilla
Mara PR-1377-EE	1	5	GRP	Aguada	Aguada
Maria	1	5	Wood	Aguadilla	Same
Maria	1	5	Wood	Aguada	Same
Maria de Lourdes	3	7	GRP	Vega Baja	Same
Mariana	1	5	GRP	Aguadilla	Same
Maribel	1	5	Other	Crash Boat	Aguadilla
Marta	1	5	Other	Aguadilla	Same
Melinda	1	7	Other	Aguadilla	Same
Mercedes	1	5	Wood	Aguadilla	Same
Mi Familia	1	6	GRP	Rincón	Same
Milagros	1	5	Wood	Isabela	Same
Municipio de Aguada #5	1	6	Other	Aguada	Same
Natasha	1	5	Other	Aguada	Same
Nathan	1	5	GRP	Rincón	Parcela Estelas Rincón
(La) Negri	1	6	GRP	Rincón	Same
Negrita	1	5	GRP	Pto. El Seco, Mayaguez	Same
Neyda	1	5	Wood	Aguadilla	Same
Nicolle	1	5	Other	Aguda	Same
No Name	1	5	Wood	Rincón	Same
Odaly	1	5	Wood	Aguada	Same
Onida II	1	5	Other	Aguadilla	Same
Orca		5	GRP	Guaniquilla	Aguada
(El) Perido	1	20	GRP	Rincón	Same
(La) Picua	1	6	GRP	Aguada	Same
Providencia	1	5	GRP	Aguadilla	Aguada
Providencia	1	5	GRP	Aguadilla	Aguada
Rebecca	1	6	Steel	Aguadilla	Same
Rey Zodiac	4	8	GRP	Carolina	Same
Sachaira	1	6	GRP	Rincón	Same
Sea Bird	1	6	GRP	Isabela	Same
Sharon 1	1	5	GRP	Aguadilla	Same
Solimar	1	5	Wood	Aguadilla	Same
Solymar	1	5	GRP	Rincón	Same
Sunssette	1	5	GRP	Aguadilla	Same
Suzua	1	6	GRP	Rincón	Same
Suzua	1	6	GRP	Rincón	Same
Tatiana	1	6	GRP	Rincón	Same
Tina	1	5	Other	Aguadilla	Same
Tita	1	5	Other	Aguadilla	Same
Tong	1	6	GRP	Aguadilla	Same
Toucan	1	5	Wood	Rincón	Same
Vikingo	2	7	GRP	Aguada	Same
Wanda	1	5	GRP	Aguadilla	Same
Wiwi	1	6	GRP	Aguada	Same
Yahira	1	5	GRP	Aguadilla	Same
Yarimar	1	5	Other	Aguadilla	Same
Yessica II	1	5	GRP	Aguadilla	Same
Zory		6	GRP	Rincón	Same
Zulma	1	5	Other	Aguda	Same
Zuly	1	5	Wood	Aguadilla	Same
Unnamed	1	5	GRP	Aguadilla	Same
Unnamed	1	6	GRP	Mayaguez	Same
Unnamed	1	7	GRP	Arecibo	Same
Unnamed	1	5	GRP	Aguadilla	Same

GRP - Glass reinforced plastic (fiberglass)
Note: The large number of angler permits are not included in this appendix. Anglers can not sell their catch.
* Now limited access. Can also use rod and reel for tunas other than bluefin.
** Commercial handgear permit. Rod and reel, handline, and harpoon allowed.
Source: NMFS, Northeast Regional Office

Appendix A6a.--Puerto Rico. Companies operating charter boats, 2001

Company	Port	Telephone	FAX
		Area code 787	
Aquatic Underwater Adventures	Aguadilla	890-6071	890-6071
Benitez, Mike Deep Sea Fishing	San Juan	723-2292	725-4344
Caribbean Outfitters	Carolina	396-8346	728-8380
Castillo Watersports	San Juan	761-6195	791-5888
Karolette Fishing Charters	Humaco	850-7442	No FAX
Lady Traveler	Fajardo	863-2821	No FAX
Light Tackle Paradise	Fajardo	874 2294	No FAX
Maragatha Charters	Humaco	850-7548	No FAX
Parguera Fishing Charters	Lajas	899-4698	899-4698
Sanabria Puchi	San Juan	796-4645	796-7323
Shiraz Charters	Humaco	285-5718	No FAX
Tropical Charters	Fajardo	863-6594	863-6594
Verges, Mike	San Juan	721-7335	721-7335
Western Tour Services	Mayaguez	834-4008	834-4008

Source: Luz M. Colon de Yoshiura, Project Leader, Marine Recreational Fisheries Statistics Survey, Puerto Rican Departamento de Recursos Naturales y Ambientales, unpublished list, May 11, 2001

Appendix A6b.--Puerto Rico. Companies operating charter boats, by port 2001

Port/Company	Telephone	FAX
	Area code 787	
Aguadilla		
Aquatic Underwater Adventures	890-6071	890-6071
Carolina		
Caribbean Outfitters	396-8346	728-8380
Fajardo		
Lady Traveler	863-2821	No FAX
Light Tackle Paradise	874 2294	No FAX
Tropical Charters	863-6594	863-6594
Humaco		
Karolette Fishing Charters	850-7442	No FAX
Maragatha Charters	850-7548	No FAX
Shiraz Charters	285-5718	No FAX
Lajas		
Parguera Fishing Charters	899-4698	899-4698
Mayaguez		
Western Tour Services	834-4008	834-4008
San Juan		
Benitez, Mike Deep Sea Fishing	723-2292	725-4344
Castillo Watersports	761-6195	791-5888
Sanabria Puchi	796-4645	796-7323
Verges, Mike	721-7335	721-7335

Source: Luz M. Colon de Yoshiura, Project Leader, Marine Recreational Fisheries Statistics Survey, Puerto Rican Departamento de Recursos Naturales y Ambientales, unpublished list, May 11, 2001

Appendix B1a.--Puerto Rico. Monthly swordfish catch data, by size, 1984

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	-	-	-	-	-	-	-	-	-	-	-	17	17
21- 40	-	-	-	-	-	-	-	-	-	-	-	59	59
41- 60	-	-	-	-	-	-	-	-	-	-	-	76	76
61- 80	-	-	-	-	-	-	-	-	-	-	-	66	66
81-100	-	-	-	-	-	-	-	-	-	-	-	69	69
101-120	-	-	-	-	-	-	-	-	-	-	-	48	48
121-140	-	-	-	-	-	-	-	-	-	-	-	29	29
141-160	-	-	-	-	-	-	-	-	-	-	-	12	12
161-180	-	-	-	-	-	-	-	-	-	-	-	15	15
181-200	-	-	-	-	-	-	-	-	-	-	-	12	12
201-220	-	-	-	-	-	-	-	-	-	-	-	7	7
221-240	-	-	-	-	-	-	-	-	-	-	-	5	5
241-260	-	-	-	-	-	-	-	-	-	-	-	2	2
261-280	-	-	-	-	-	-	-	-	-	-	-	3	3
281-300	-	-	-	-	-	-	-	-	-	-	-	3	3
301-320	-	-	-	-	-	-	-	-	-	-	-	1	1
321-340	-	-	-	-	-	-	-	-	-	-	-	4	4
401-420	-	-	-	-	-	-	-	-	-	-	-	1	1
581-600	-	-	-	-	-	-	-	-	-	-	-	1	1
Total	-	-	-	-	-	-	-	-	-	-	-	430	430

Source: Southeast Fisheries Science Center

Appendix B1b.--Puerto Rico. Monthly swordfish catch data, by size, 1985

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	9	7	24	7	5	-	-	-	-	8	28	68	156
21- 40	76	63	123	67	16	-	-	-	-	15	37	222	619
41- 60	160	173	232	109	27	-	-	-	-	18	55	258	1,032
61- 80	167	220	257	106	29	-	-	-	-	27	59	282	1,147
81-100	161	230	190	76	23	-	-	-	-	16	47	186	929
101-120	116	144	132	43	14	-	-	-	-	12	12	99	572
121-140	78	95	105	31	9	-	-	-	-	4	8	47	377
141-160	49	74	69	25	6	-	-	-	-	-	7	37	267
161-180	32	36	47	11	6	-	-	-	-	1	3	19	155
181-200	24	29	27	7	3	-	-	-	-	2	5	12	109
201-220	25	18	24	11	-	-	-	-	-	-	2	14	94
221-240	15	22	17	7	4	-	-	-	-	1	2	12	80
241-260	15	5	15	5	2	-	-	-	-	-	2	13	57
261-280	9	11	9	7	2	-	-	-	-	-	-	5	43
281-300	5	6	11	1	4	-	-	-	-	-	-	4	31
301-320	3	2	9	1	-	-	-	-	-	-	-	6	21
321-340	3	2	7	2	-	-	-	-	-	-	-	1	15
341-360	4	2	4	-	1	-	-	-	-	-	-	3	14
361-380	3	1	5	2	1	-	-	-	-	-	-	1	13
381-400	1	1	1	1	-	-	-	-	-	-	-	-	4
401-420	2	1	1	2	1	-	-	-	-	-	-	1	8
421-440	-	2	2	-	-	-	-	-	-	-	-	-	4
441-460	1	-	4	1	-	-	-	-	-	-	-	-	6
461-480	1	-	1	2	-	-	-	-	-	-	-	-	4
481-500	2	-	1	-	-	-	-	-	-	-	-	2	3
500-520	-	-	-	-	-	-	-	-	-	-	-	2	2
541-560	-	-	2	1	-	-	-	-	-	-	-	4	7
561-580	-	-	1	1	-	-	-	-	-	1	-	-	3
Total	961	1,145	1,320	527	153	-	-	-	-	105	267	1,296	5,774

* Totals may not add because 2 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1c.--Puerto Rico. Monthly swordfish catch data, by size, 1986

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	215	244	125	175	138	53	79	15	11	96	30	104	1285
21- 40	586	821	727	637	361	173	150	62	152	124	178	252	4223
41- 60	597	753	669	660	293	183	87	53	193	157	172	318	4135
61- 80	592	740	555	663	406	214	104	67	161	176	223	412	4313
81-100	454	529	415	513	331	152	88	53	145	137	158	334	3309
101-120	237	325	254	267	163	61	24	8	86	69	93	195	1782
121-140	142	221	167	130	68	14	7	3	48	27	17	109	953
141-160	97	154	120	67	36	3	3	1	28	9	15	54	587
161-180	69	111	87	57	14	1	-	1	18	3	10	35	406
181-200	53	76	60	39	12	1	-	-	7	3	3	13	167
201-220	31	43	37	31	7	2	-	-	1	3	4	10	169
221-240	30	41	37	31	1	1	-	-	1	2	2	11	157
241-260	20	27	19	20	6	1	-	-	2	1	1	8	105
261-280	25	22	18	25	4	2	1	1	1	2	-	13	114
281-300	17	18	14	14	4	1	-	-	-	-	1	7	76
301-320	9	12	13	7	5	1	-	-	-	1	-	4	52
321-340	7	11	9	5	2	-	-	-	-	1	-	4	39
341-360	7	2	7	7	3	-	-	-	-	-	1	4	31
361-380	2	10	6	7	-	-	-	-	-	-	-	-	25
381-400	2	6	5	1	1	-	-	-	-	-	-	1	16
401-420	3	5	4	4	1	-	1	-	-	-	-	2	20
421-440	3	5	3	3	-	-	-	-	-	-	-	1	15
441-460	1	1	-	3	-	1	-	-	-	-	-	-	6
461-480	1	1	2	2	-	-	-	-	1	-	-	1	8
481-500	2	1	-	1	-	-	-	-	-	-	-	-	5
501-520	-	1	-	-	1	-	-	-	-	1	-	-	3
521-540	-	1	2	-	-	-	-	-	-	-	-	-	3
541-550	-	1	1	-	-	-	-	-	-	-	-	-	2
571-580	-	-	1	-	-	-	-	-	-	-	-	-	1
611-720	-	1	-	-	-	-	-	-	-	-	-	1	2
Total*	3,202	4,183	3,358	3,371	1,857	865	544	264	855	812	908	1,896	22,115

* Totals may not add because 5 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1d.--Puerto Rico. Monthly swordfish catch data, by size, 1987

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	43	144	151	306	345	132	83	99	19	56	68	96	1,542
21- 40	279	479	603	624	663	281	262	322	108	135	217	444	4,417
41- 60	313	521	697	555	514	214	214	144	44	83	147	273	3,719
61- 80	328	427	533	445	345	178	181	131	47	78	109	237	3,039
81-100	192	281	399	282	177	132	144	74	30	39	68	135	1,953
101-120	149	176	227	167	90	78	99	47	14	25	23	53	1,146
121-140	73	87	125	97	50	47	55	20	8	8	13	24	607
141-160	49	61	76	74	28	22	36	16	6	7	7	14	396
161-180	28	41	60	43	17	9	10	4	6	3	12	19	252
181-200	24	23	40	23	12	8	4	1	2	2	4	12	155
201-220	33	28	31	31	13	2	-	1	2	1	-	6	148
221-240	15	15	21	13	7	3	1	1	1	3	1	5	86
241-260	10	19	20	16	8	2	3	-	1	-	1	4	84
261-280	12	18	15	18	8	3	-	-	-	-	3	7	83
281-300	14	10	8	11	7	-	1	-	1	2	-	2	56
301-320	6	14	12	4	4	4	-	-	1	1	1	4	51
321-340	10	6	5	9	4	1	-	-	-	2	3	3	43
341-360	3	4	8	7	2	2	-	-	1	1	1	6	35
361-380	4	3	6	5	1	3	-	-	1	2	1	3	29
381-400	7	3	10	1	2	2	-	-	-	-	1	1	27
401-420	2	1	7	1	2	-	-	-	-	-	-	1	14
421-440	2	2	5	2	-	-	-	-	-	1	-	-	17
441-460	4	3	1	1	3	1	-	-	-	-	-	-	13
461-480	-	-	5	2	-	-	-	-	-	1	2	-	10
481-500	1	1	-	-	-	-	-	-	-	-	1	3	6
501-520	1	-	2	-	-	-	-	-	-	1	-	-	4
521-540	-	-	2	-	1	-	-	-	-	-	-	-	3
541-560	-	-	1	-	-	-	-	-	-	-	-	1	2
601-620	1	-	-	-	-	-	-	-	-	-	-	-	1
Total	1,603	2,367	3,070	2,738	2,303	1,124	1,093	860	292	451	683	1,358	17,943

* Totals may not add because 5 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1e.--Puerto Rico. Monthly swordfish catch data, by size, 1988

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	63	46	122	156	148	41	44	26	61	107	44	238	1,096
21- 40	295	187	411	472	395	173	197	108	115	122	138	392	3,005
41- 60	258	183	315	362	304	103	172	76	63	105	87	310	2,338
61- 80	204	195	245	231	208	78	104	32	34	63	53	211	1,618
81-100	95	95	153	151	87	32	38	20	15	31	20	74	813
101-120	53	69	108	60	43	18	16	13	6	15	7	37	445
121-140	33	39	47	29	17	8	6	11	5	11	6	24	236
141-160	27	24	34	18	12	3	7	8	4	2	2	18	159
161-180	10	17	23	12	10	3	7	4	-	4	3	7	100
181-200	13	18	15	13	5	2	3	-	1	5	1	6	82
201-220	5	7	17	8	4	1	4	1	1	-	1	5	54
221-240	3	11	17	13	6	4	2	3	-	5	2	3	69
241-260	5	8	7	7	6	3	2	2	-	4	-	2	46
261-280	1	6	9	2	5	3	2	3	-	1	1	6	39
281-300	1	2	4	4	7	2	1	2	-	2	-	5	30
301-320	5	1	2	7	8	1	-	-	-	1	1	3	29
321-340	1	0	6	6	-	1	3	2	1	-	-	4	24
341-360	1	5	7	4	1	2	1	1	1	-	-	2	25
361-380	-	3	-	2	1	-	3	1	-	1	1	-	12
381-400	1	2	2	-	1	-	2	-	1	-	-	1	10
401-420	-	-	1	2	2	2	1	-	-	-	-	3	11
421-440	-	-	-	1	3	1	-	-	1	1	-	-	7
441-460	3	-	1	-	-	2	-	-	-	-	-	2	8
481-500	-	1	-	-	-	-	1	-	-	-	-	2	4
501-520	-	1	1	-	-	-	-	-	-	-	-	-	2
521-540	-	1	-	-	-	-	-	-	-	1	-	-	2
541-560	-	-	-	-	-	-	-	-	-	-	-	-	-
561-580	-	-	-	-	-	-	-	-	-	-	-	-	-
581-600	-	-	1	-	-	-	-	-	-	-	-	-	1
601-620	-	-	-	-	-	-	1	-	-	-	-	-	1
Total	1,077	883	1,548	1,560	1,273	483	617	313	310	481	367	1,356	10,268

* Totals may not add because 2 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1f.--Puerto Rico. Monthly swordfish catch data, by size, 1989

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	19	27	52	70	15	42	-	-	-	-	-	26	251
21- 40	91	137	223	162	49	163	-	-	-	-	2	142	969
41- 60	120	157	211	165	40	73	-	-	-	-	25	196	987
61- 80	83	98	94	94	11	28	-	-	-	-	8	171	587
81-100	76	100	49	53	9	9	-	-	-	-	4	144	444
101-120	48	68	34	17	2	2	-	-	-	-	4	99	274
121-140	30	42	25	7	1	-	-	-	-	-	2	54	161
141-160	22	29	13	5	-	1	-	-	-	-	1	40	111
161-180	8	18	7	3	-	1	-	-	-	-	-	24	61
181-200	7	10	14	2	1	-	-	-	-	-	-	14	48
201-220	6	7	10	3	-	1	-	-	-	-	1	10	38
221-240	5	13	7	1	2	1	-	-	-	-	2	7	38
241-260	4	5	3	1	1	-	-	-	-	-	-	10	24
261-280	2	2	5	3	-	-	-	-	-	-	-	10	22
281-300	4	-	2	-	-	-	-	-	-	-	-	-	6
301-320	2	2	1	1	-	-	-	-	-	-	1	2	9
321-340	3	2	-	1	-	-	-	-	-	-	-	2	8
341-360	3	-	1	-	1	-	-	-	-	-	-	-	5
361-380	-	1	1	-	-	-	-	-	-	-	-	1	3
381-400	2	1	3	-	-	-	-	-	-	-	-	-	6
401-420	2	-	1	-	-	-	-	-	-	-	-	-	3
421-440	-	1	-	-	-	-	-	-	-	-	-	1	2
441-460	1	-	1	1	2	-	-	-	-	-	-	-	5
461-470	1	-	-	-	-	-	-	-	-	-	-	-	1
481-490	-	-	-	-	-	-	-	-	-	-	-	1	1
511-520	-	-	-	-	-	-	-	-	-	-	-	1	1
Total	539	721	757	589	134	321	-	-	-	-	50	956	4,067

* Totals may not add because 2 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1g.--Puerto Rico. Monthly swordfish catch data, by size, 1990

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	9	24	1	-	7	-	-	-	-	-	-	45	86
21- 40	100	242	56	-	43	-	-	-	-	-	-	143	534
41- 60	190	408	69	-	38	-	-	-	-	-	-	250	953
61- 80	211	508	95	-	14	-	-	-	-	-	-	201	1,029
81- 100	205	481	81	-	12	-	-	-	-	-	-	159	938
101-120	127	365	54	-	1	-	-	-	-	-	-	84	631
121-140	79	214	42	-	3	-	-	-	-	-	-	57	395
141-160	54	128	31	-	1	-	-	-	-	-	-	30	244
161-180	25	83	13	-	-	-	-	-	-	-	-	10	131
181-200	24	76	9	-	-	-	-	-	-	-	-	15	124
201-220	21	55	4	-	1	-	-	-	-	-	-	12	93
221-240	12	41	2	-	-	-	-	-	-	-	-	7	62
241-260	18	26	2	-	-	-	-	-	-	-	-	1	47
261-280	14	18	1	-	-	-	-	-	-	-	-	4	37
281-300	5	14	2	-	-	-	-	-	-	-	-	7	28
301-320	2	5	1	-	-	-	-	-	-	-	-	2	10
321-340	3	8	1	-	-	-	-	-	-	-	-	1	13
351-360	1	-	1	-	1	-	-	-	-	-	-	3	8
361-370	1	1	-	-	-	-	-	-	-	-	-	-	2
371-380	-	1	-	-	-	-	-	-	-	-	-	-	1
381-390	1	-	-	-	-	-	-	-	-	-	-	-	1
391-400	1	-	-	-	-	-	-	-	-	-	-	-	1
411-420	1	1	1	-	-	-	-	-	-	-	-	-	3
431-440	-	-	1	-	-	-	-	-	-	-	-	-	1
551-560	-	1	-	-	-	-	-	-	-	-	-	-	1
Total	1,105	2,701	467	-	121	-	-	-	-	-	-	1,029	5,423

* Totals may not add because 2 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1h.--Puerto Rico. Monthly swordfish catch data, by size, 1991

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	45	12	55	49	16	-	-	-	-	-	-	10	187
21- 40	126	114	114	207	57	-	-	-	-	-	-	83	701
41- 60	300	340	230	231	44	-	-	-	-	-	-	152	1,297
61- 80	283	388	144	156	17	-	-	-	-	-	-	171	1,159
81- 100	200	360	130	58	10	-	-	-	-	-	-	128	886
101-120	119	245	98	20	3	-	-	-	-	-	-	85	570
121-140	80	153	58	9	1	-	-	-	-	-	-	64	365
141-160	60	88	32	8	-	-	-	-	-	-	-	30	218
161-180	34	68	19	3	1	-	-	-	-	-	-	25	150
181-200	23	40	7	2	-	-	-	-	-	-	-	20	92
201-220	12	39	11	3	-	-	-	-	-	-	-	12	77
221-240	11	20	5	1	1	-	-	-	-	-	-	7	45
241-260	13	11	6	2	-	-	-	-	-	-	-	8	40
261-280	7	8	3	4	-	-	-	-	-	-	-	5	27
281-300	3	7	3	-	-	-	-	-	-	-	-	2	15
301-320	5	11	1	1	-	-	-	-	-	-	-	3	21
321-340	6	7	1	1	-	-	-	-	-	-	-	2	17
341-360	2	4	-	-	-	-	-	-	-	-	-	1	7
361-380	1	3	-	-	-	-	-	-	-	-	-	3	7
381-400	1	1	-	2	-	-	-	-	-	-	-	-	4
401-420	3	-	-	-	1	-	-	-	-	-	-	-	4
431-440	1	-	-	-	-	-	-	-	-	-	-	1	2
451-460	-	1	-	-	-	-	-	-	-	-	-	-	1
481-490	-	1	-	-	-	-	-	-	-	-	-	-	1
501-510	-	-	-	1	-	-	-	-	-	-	-	-	1
621-630	-	-	1	-	-	-	-	-	-	-	-	-	1
Total	1,355	1,924	919	758	151	-	-	-	-	-	-	812	5,899

* Totals may not add because 4 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1i.--Puerto Rico. Monthly swordfish catch data, by size, 1992

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	5	5	-	5	-	-	-	-	-	-	-	-	15
21- 40	131	125	66	64	-	-	-	-	-	-	-	86	472
41- 60	293	268	251	161	-	-	-	-	-	-	-	179	1,152
61- 80	331	321	241	137	-	-	-	-	-	-	-	115	1,145
81-100	298	271	148	60	-	-	-	-	-	-	-	105	882
101-120	172	142	94	25	-	-	-	-	-	-	-	86	519
121-140	99	94	71	14	-	-	-	-	-	-	-	47	325
141-160	87	78	37	11	-	-	-	-	-	-	-	32	245
161-180	54	39	20	7	-	-	-	-	-	-	-	21	141
181-200	53	41	20	2	-	-	-	-	-	-	-	17	133
201-220	35	36	11	2	-	-	-	-	-	-	-	14	98
221-240	31	27	11	-	-	-	-	-	-	-	-	4	73
241-260	15	12	7	-	-	-	-	-	-	-	-	8	42
261-280	18	17	8	1	-	-	-	-	-	-	-	4	48
281-300	5	6	3	-	-	-	-	-	-	-	-	2	16
301-320	6	4	3	-	-	-	-	-	-	-	-	-	13
321-340	8	2	1	1	-	-	-	-	-	-	-	2	14
341-360	2	1	-	-	-	-	-	-	-	-	-	2	5
361-380	2	-	-	-	-	-	-	-	-	-	-	-	2
381-400	1	-	-	-	-	-	-	-	-	-	-	-	1
401-420	1	1	1	1	-	-	-	-	-	-	-	2	6
421-440	-	-	-	-	-	-	-	-	-	-	-	2	2
441-460	-	-	1	-	-	-	-	-	-	-	-	1	2
461-480	-	-	-	1	-	-	-	-	-	-	-	-	1
481-500	-	-	-	-	-	-	-	-	-	-	-	-	-
521-540	-	-	-	-	-	-	-	-	-	-	-	-	-
541-560	1	1	-	-	-	-	-	-	-	-	-	-	2
561-580	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,649	1,491	994	492	-	-	-	-	-	-	-	729	5,355

* Totals may not add because 1 fish was not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1j.--Puerto Rico. Monthly Swordfish Catch data, by Size, 1993

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	5	1	5	-	-	-	-	-	-	-	-	17	28
21- 40	81	101	141	-	-	-	-	-	-	-	-	27	350
41- 60	160	288	353	-	-	-	-	-	-	-	-	87	888
61- 80	162	365	344	-	-	-	-	-	-	-	-	71	942
81-100	151	456	217	-	-	-	-	-	-	-	-	75	899
101-120	121	316	123	-	-	-	-	-	-	-	-	43	603
121-140	72	185	77	-	-	-	-	-	-	-	-	31	365
141-160	31	124	49	-	-	-	-	-	-	-	-	13	217
161-180	33	79	41	-	-	-	-	-	-	-	-	9	162
181-200	18	58	30	-	1	-	-	-	-	-	-	11	118
201-220	17	39	26	-	-	-	-	-	-	-	-	6	88
221-240	9	29	19	-	-	-	-	-	-	-	-	6	63
241-260	13	30	9	-	-	-	-	-	-	-	-	-	52
261-280	4	10	3	-	-	-	-	-	-	-	-	1	18
281-300	3	9	5	-	-	-	-	-	-	-	-	2	19
301-320	1	5	2	-	-	-	-	-	-	-	-	-	8
321-340	5	4	2	-	-	-	-	-	-	-	-	2	13
341-360	-	4	-	-	-	-	-	-	-	-	-	2	6
361-380	-	2	3	-	-	-	-	-	-	-	-	-	5
381-400	-	2	-	-	-	-	-	-	-	-	-	-	2
401-420	3	1	1	-	-	-	-	-	-	-	-	-	5
421-440	1	2	-	-	-	-	-	-	-	-	-	-	3
441-460	-	-	-	-	-	-	-	-	-	-	-	-	-
461-480	-	-	-	-	-	-	-	-	-	-	-	-	-
501-520	-	-	-	-	-	-	-	-	-	-	-	-	-
521-540	-	-	-	-	-	-	-	-	-	-	-	-	-
561-580	1	-	-	-	-	-	-	-	-	-	-	-	1
Total	891	2,110	1,450	-	1	-	-	-	-	-	-	403	4,855

Source: Southeast Fisheries Science Center

Appendix B1k.--Puerto Rico. Monthly Swordfish Catch data, by Size, 1994

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	4	7	-	5	9	19	-	2	6	10	-	4	66
21- 40	47	82	184	154	129	113	21	31	13	75	81	121	1,051
41- 60	132	177	606	209	184	284	37	32	37	61	116	237	2,112
61- 80	168	200	396	184	194	333	22	27	27	45	94	204	1,894
81-100	152	193	256	92	147	199	13	7	12	15	27	149	1,262
101-120	118	157	105	28	43	80	11	-	3	3	22	112	682
121-140	77	80	54	11	18	27	1	3	3	1	6	64	345
141-160	37	79	37	5	16	16	2	3	2	-	6	39	242
161-180	40	59	26	3	6	5	-	-	-	-	1	29	169
181-200	28	25	17	5	2	4	1	-	-	-	3	22	107
201-220	20	29	11	1	2	2	-	1	-	-	2	15	83
221-240	22	23	12	-	2	4	-	-	1	-	2	12	79
241-260	8	16	5	1	1	6	-	-	-	-	1	11	48
261-280	6	12	10	-	-	2	1	-	-	-	1	9	41
281-300	4	4	2	-	-	1	-	-	-	-	-	6	17
301-320	5	2	4	-	-	1	-	-	-	-	-	1	13
321-340	2	5	1	1	1	-	-	-	-	-	-	5	15
341-360	1	-	1	-	-	1	-	-	-	-	1	3	7
361-380	4	1	-	-	1	-	-	-	-	-	1	1	8
381-400	-	1	-	-	-	-	-	-	-	-	-	1	2
401-420	1	-	-	-	-	-	-	-	-	-	-	1	2
421-440	1	1	-	-	1	-	-	-	-	-	-	1	4
441-460	-	-	-	-	-	-	-	-	-	-	-	-	-
461-480	-	-	-	-	-	-	-	-	-	-	-	-	-
481-500	-	-	-	-	-	-	-	-	-	-	-	-	-
521-540	-	-	-	-	-	-	-	-	-	-	-	-	-
581-600	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	878	1,153	1,727	699	756	1,097	109	106	104	210	364	1,047	8,250

* Totals may not add because 1 fish was not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1l.--Puerto Rico. Monthly swordfish catch data, by size, 1995

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	13	21	11	4	1	16	-	-	-	-	-	-	66
21- 40	199	297	195	149	296	179	25	-	14	-	1	-	1,355
41- 60	486	968	606	481	579	299	100	-	56	-	14	-	3,589
61- 80	458	1,094	561	487	811	410	128	-	24	-	5	-	3,978
81-100	421	913	322	305	549	349	88	-	12	-	2	-	2,961
101-120	311	618	186	86	160	123	19	-	5	-	1	-	1,509
121-140	221	339	116	34	72	38	6	-	1	-	1	-	828
141-160	140	217	57	24	43	21	6	-	1	-	-	-	509
161-180	90	137	32	21	46	25	10	-	-	-	-	-	361
181-200	59	102	32	13	39	18	4	-	2	-	1	-	270
201-220	42	61	21	10	17	10	1	-	-	-	-	-	162
221-240	39	58	19	13	14	11	2	-	-	-	-	-	156
241-260	29	44	7	3	14	8	-	-	-	-	-	-	105
261-280	18	24	8	8	13	8	2	-	-	-	-	-	81
281-300	12	18	6	1	7	5	-	-	-	-	-	-	49
301-320	9	13	5	3	7	4	-	-	-	-	-	-	41
321-340	5	4	4	2	7	4	1	-	-	-	-	-	27
341-360	3	7	2	2	4	1	-	-	-	-	-	-	19
361-380	1	4	3	1	3	1	-	-	-	-	-	-	13
381-400	-	1	-	1	-	-	-	-	-	-	-	-	2
401-420	-	1	1	-	4	1	-	-	-	-	-	-	7
421-440	2	1	-	-	1	1	-	-	-	-	-	-	5
441-460	-	1	-	-	-	1	-	-	-	-	-	-	2
461-480	-	1	-	-	-	1	-	-	-	-	-	-	2
481-500	-	-	1	1	-	-	-	-	-	-	-	-	2
541-560	-	1	-	-	-	-	-	-	-	-	-	-	1
561-580	-	-	-	-	-	-	-	-	-	-	-	-	-
581-600	1	-	-	-	1	-	-	-	-	-	-	-	2
601-620	-	-	-	-	-	-	-	-	-	-	-	-	-
621-640	1	-	-	-	-	-	-	-	-	-	-	-	1
Total	2,560	4,949	2,195	1,650	2,689	1,534	392	-	115	-	26	-	16,110

* Totals may not add because 7 fish were not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1m.--Puerto Rico. Monthly swordfish catch data, by size, 1996

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
01- 20	3	-	4	1	4	5	-	-	-	-	-	-	17
21- 40	22	44	242	221	99	115	26	30	24	113	46	103	1,085
41- 60	47	77	675	627	251	162	51	82	34	142	77	171	2,396
61- 80	54	50	346	289	104	73	25	21	23	64	57	124	1,230
81- 100	42	23	113	89	37	37	25	7	7	28	29	53	490
101-120	31	17	47	37	16	15	7	6	1	7	11	39	234
121-140	10	17	23	19	7	4	4	2	-	6	3	24	119
141-160	17	9	13	8	4	6	2	2	2	2	5	14	84
161-180	6	6	23	9	4	2	1	1	-	1	4	6	63
181-200	6	3	5	5	4	3	1	-	1	2	5	8	43
201-220	-	4	13	11	-	1	-	-	-	1	2	8	40
221-240	6	1	10	8	2	4	-	-	-	-	1	5	37
241-260	4	1	4	5	1	-	-	-	-	-	-	3	18
261-280	2	1	9	6	1	-	-	-	-	1	1	3	24
281-300	2	1	7	-	1	-	-	-	-	-	-	1	12
301-320	1	1	3	1	-	1	1	-	-	-	-	1	9
321-340	-	-	1	-	-	1	-	-	1	-	1	3	7
341-360	-	-	-	3	1	-	1	1	-	-	-	-	6
361-380	-	1	2	1	-	-	-	-	-	-	-	1	5
381-400	-	-	1	1	-	-	-	-	-	-	-	-	2
401-410	-	-	-	-	-	-	-	-	-	-	-	1	1
421-440	-	-	-	1	-	1	-	-	-	-	1	-	3
451-460	-	-	-	-	1	-	-	-	-	-	-	-	1
461-470	-	-	1	-	-	-	-	-	-	-	-	-	1
481-490	-	-	-	1	-	-	-	-	-	-	-	-	1
531-540	-	1	1	-	-	-	-	-	-	-	-	-	2
Total	253	257	1,543	1,343	537	430	144	152	93	367	243	568	5,930

Source: Southeast Fisheries Science Center

Appendix B1n.--Puerto Rico. Monthly swordfish catch data, by size, 1997

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
21- 40	62	87	96	33	-	50	95	46	53	-	-	30	552
41- 60	136	159	150	83	-	64	64	50	61	-	-	49	816
61- 80	82	116	99	43	-	26	26	23	20	-	-	32	467
81- 100	55	42	47	26	-	6	12	14	3	-	-	26	231
101-120	37	38	19	14	-	1	1	6	4	-	-	19	139
121-140	37	36	12	11	-	-	1	3	5	-	-	7	112
141-160	22	23	8	6	-	2	2	1	1	-	-	9	74
161-180	13	17	5	7	-	1	-	-	-	-	-	6	50
181-200	12	12	6	2	-	-	-	-	1	-	-	2	35
201-220	8	7	4	1	-	-	-	-	1	-	-	2	23
221-240	2	3	1	-	-	-	-	-	-	-	-	-	6
241-260	3	4	1	5	-	1	-	-	-	-	-	-	14
261-280	2	3	1	2	-	-	1	1	-	-	-	2	12
281-300	1	1	3	-	-	-	-	-	-	-	-	1	6
301-320	-	1	-	1	-	-	1	-	-	-	-	-	3
321-330	1	-	2	-	-	-	-	-	-	-	-	-	3
341-360	1	-	-	1	-	-	-	-	-	-	-	1	3
371-380	-	-	-	-	-	-	-	-	1	-	-	-	1
391-400	-	-	1	-	-	-	-	-	-	-	-	1	2
411-420	1	-	-	-	-	-	-	-	-	-	-	-	1
431-440	1	-	-	-	-	-	-	-	-	-	-	-	1
691-700	-	-	-	-	-	-	1	-	-	-	-	-	1
Total	476	549	455	235	-	152	204	144	150	-	-	188	2,553

* Totals may not add because 1 fish was not classified within noted parameters.
Source: Southeast Fisheries Science Center

Appendix B1o.--Puerto Rico. Monthly swordfish catch data, by size, 1998

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds	Number of fish												
31- 50	49	72	50	15	-	-	-	-	-	-	-	21	207
51- 70	54	57	47	6	-	-	-	-	-	-	-	12	176
71- 90	18	33	19	2	-	-	-	-	-	-	-	8	80
91-110	11	14	6	1	-	-	-	-	-	-	-	11	43
111-130	5	9	3	-	-	-	-	-	-	-	-	9	26
131-150	9	7	2	-	-	-	-	-	-	-	-	5	23
151-170	1	3	3	1	-	-	-	-	-	-	-	9	17
171-190	4	5	2	-	-	-	-	-	-	-	-	-	11
191-210	5	1	1	1	-	-	-	-	-	-	-	3	11
211-230	1	4	-	-	-	-	-	-	-	-	-	1	6
231-250	3	1	1	-	-	-	-	-	-	-	-	1	6
251-270	-	1	1	-	-	-	-	-	-	-	-	1	3
271-290	-	-	-	1	-	-	-	-	-	-	-	3	4
291-310	2	2	-	-	-	-	-	-	-	-	-	1	5
321-340	1	-	-	-	-	-	-	-	-	-	-	1	2
Total	163	209	135	27	-	-	-	-	-	-	-	86	620

Source: Southeast Fisheries Science Center

Appendix B1p.--Puerto Rico. Monthly swordfish catch data, by size, 1999

Weight	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Pounds						Number of fish							
21- 40	22	22	4	1	-	-	-	-	-	-	-	-	49
41- 60	65	56	12	3	-	-	-	-	-	-	-	-	136
61- 80	37	37	5	2	-	-	-	-	-	-	-	-	81
81-100	25	21	2	-	-	-	-	-	-	-	-	-	48
101-120	12	23	-	-	-	-	-	-	-	-	-	-	35
121-140	16	10	1	1	-	-	-	-	-	-	-	-	28
141-160	7	11	2	1	-	-	-	-	-	-	-	-	21
161-180	9	3	-	-	-	-	-	-	-	-	-	-	12
181-200	1	7	-	-	-	-	-	-	-	-	-	-	8
201-220	4	5	-	-	-	-	-	-	-	-	-	-	9
221-240	-	3	-	-	-	-	-	-	-	-	-	-	3
241-260	2	2	-	-	-	-	-	-	-	-	-	-	4
261-280	-	2	-	-	-	-	-	-	-	-	-	-	2
281-300	1	-	-	-	-	-	-	-	-	-	-	-	1
301-320	3	-	-	-	-	-	-	-	-	-	-	-	3
360-380	1	-	-	-	-	-	-	-	-	-	-	-	1
Total	205	202	26	8	-	-	-	-	-	-	-	-	441

Source: Southeast Fisheries Science Center

Appendix B2a.--Puerto Rico. Monthly swordfish catch data, by size, 1984

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Pounds							
Mean size	-	-	-	-	-	-	-	-	-	-	-	92	92*
Total	-	-	-	-	-	-	-	-	-	-	-	39,963	39,363

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2b.--Puerto Rico. Monthly swordfish catch data, by size, 1985

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Pounds												
Mean size	105	102	102	96	101	-	-	-	-	76	71	80	95*
Total	101,273	117,073	135,583	50,831	27,200	-	-	-	-	7994	19009	104,679	563,642

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2c.--Puerto Rico Monthly swordfish catch data, by size, 1987

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Pounds												
Mean size	89	77	80	71	58	65	66	52	64	63	61	71	71*
Total	144,044	188,629	250,927	243,208	134,383	73,843	73,007	45,415	18,803	28,597	41,673	135,645	1,378,219

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2d.--Puerto Rico. Monthly swordfish catch data, by size, 1988

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Pounds												
Mean size	72	79	72	67	59	62	62	65	53	56	51	65	66*
Total	102,543	85,779	126,841	128,521	96,266	33,277	38,713	20,405	23,477	27,401	18,836	132,354	834,413

*Average mean size
Source: Southeast Fisheries Science Center

Appendix B2e.--Puerto Rico. Monthly Swordfish Catch data, by Size, 1992

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Pounds							
Mean size	100	98	93	80	78	-	-	-	-	79	81	94	94*
Total	207,495	259,534	172,724	77,768	20,062	-	-	-	-	10,909	14,220	143,383	906,095

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2f.--Puerto Rico. Monthly Swordfish Catch data, by Size, 1993

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Pounds							
Mean size	102	101	92	92	91	73	-	-	-	83	86	88	95*
Total	173,517	347,919	277,991	101,942	48,832	7,911	-	-	-	7,693	39,858	123,735	1,129,398

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2g.--Puerto Rico. Monthly Swordfish Catch data, by Size, 1994

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Pounds							
Mean size	101	102	81	68	70	72	67	58	62	61	73	89	85*
Total	153,191	260,963	212,807	86,568	53,513	82,803	7,338	6,197	6,542	23,153	48,426	209,639	1,151,140

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2h.--Puerto Rico. Monthly swordfish catch data, by size, 1995

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
							Pounds						
Mean size	97	94	85	79	82	81	72	59	61	59	-	-	87*
Total	376,595	595,541	315,841	188,348	227,077	129,920	39,766	29,896	41,439	715	-	-	1,945,138

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2i.--Puerto Rico. Monthly swordfish catch data, by size, 1996

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
							Pounds						
Mean size	94	81	67	64	61	61	70	58	60	56	73	78	
Total	23,957	21,017	104,468	87,116	33,113	26,567	10,118	8,912	5,651	20,776	17,772	44,397	403,864

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2j.--Puerto Rico. Monthly swordfish catch data, by size, 1997

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
							Pounds						
Mean size	87	82	70	79	-	54	55	59	56	-	-	86	74
Total	41,867	45,078	32,189	18,645	-	8,345	11,256	8,572	8,517	-	-	16,244	190,713

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B2k.--Puerto Rico. Monthly swordfish catch data, by size, 1998

Weight	Month												Average/Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Pounds							
Mean size	81	76	68	68	-	-	-	-	-	-	-	86	620
Total	13,340	15,952	9,313	1,861	-	-	-	-	-	-	-	109	49,882

* Average mean size
Source: Southeast Fisheries Science Center

Appendix B3.--Puerto Rico. Seasonal swordfish landings data

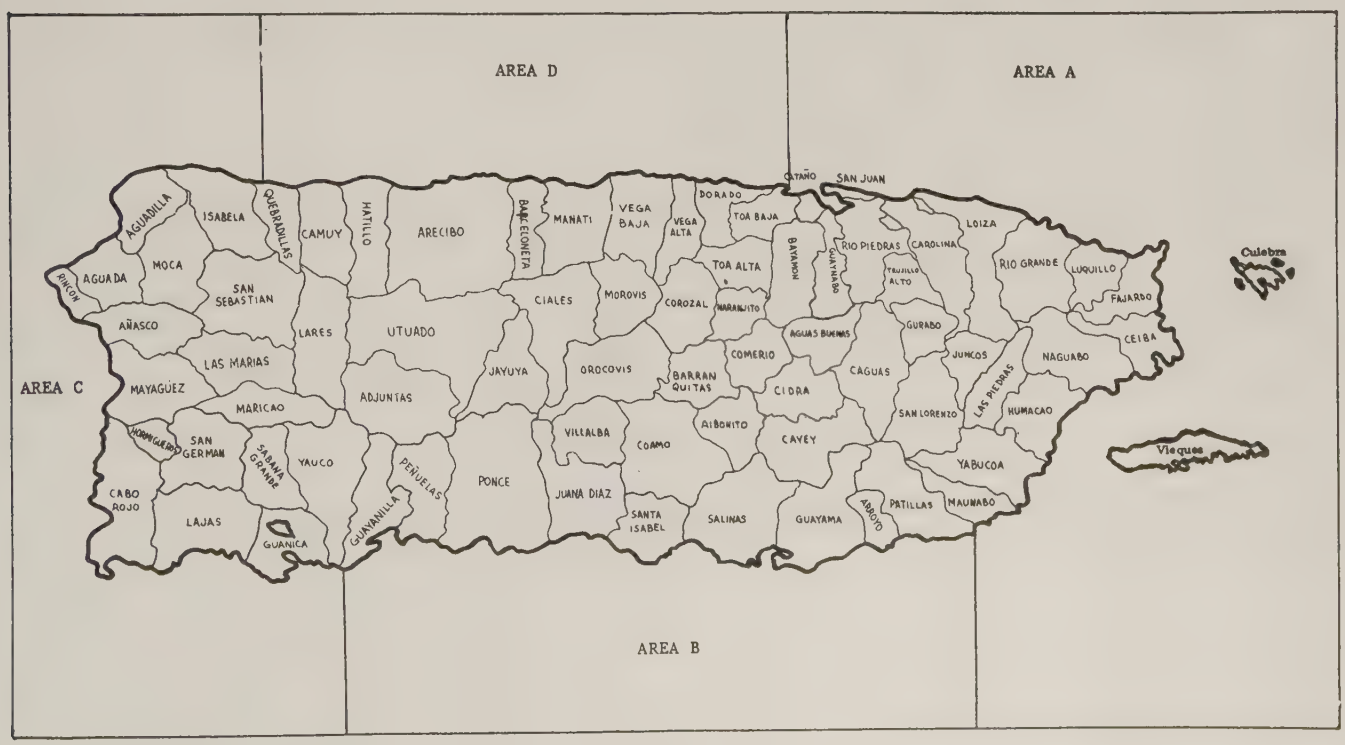
Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
						Number of fish							
1984	-	-	-	-	-	-	-	-	-	-	-	430	430
1985	961	1,145	1,320	527	153	-	-	-	-	105	267	1,296	5,774
1986	3,202	4,183	3,358	3,371	1,857	865	544	264	855	812	908	1,896	22,115
1987	1,603	2,367	3,070	2,738	2,303	1,124	1,093	860	292	451	683	1,358	17,943
1988	1,077	883	1,548	1,560	1,273	483	617	313	310	481	367	1,356	10,268
1989	539	721	757	589	134	321	-	-	-	-	50	956	4,067
1990	1,105	2,701	467	-	121	-	-	-	-	-	-	1,029	5,423
1991	1,355	1,924	919	758	151	-	-	-	-	-	-	812	5,899
1992	1,649	1,491	994	492	-	-	-	-	-	-	-	729	5,355
1993	891	2,110	1,450	-	1	-	-	-	-	-	-	403	4,855
1994	878	1,153	1,727	699	756	1,097	109	106	104	210	364	1,047	8,250
1995	2,560	4,949	2,195	1,650	2,689	1,534	392	-	115	-	26	-	16,110
1996	253	257	1,543	1,343	537	430	144	152	93	367	243	568	5,930
1997	476	549	455	235	-	152	204	144	150	-	-	188	2,553
1998	163	209	135	27	-	-	-	-	-	-	-	86	620
1999	205	202	26	8	-	-	-	-	-	-	-	-	441

Source: Southeast Fisheries Science Center

Appendix C1.--Puerto Rico. Active artisanal# and longline gear, by port, 1995-96

Coast/ Municipality	Fishermen*	Longline gear	Coast/ Municipality	Fishermen*	Longline gear
	Number				
North coast			South coast		
Isabella	18	5	Patillas	11	6
Camuy	-	-	Arroyo	15	5
Hatillo	-	-	Guayama	30	30
Arecibo	25	56	Salinas	34	30
Barcelona	17	23	Santa Isabel	25	37
Manati	2	-	Juana Diaz	25	5
Vega Baja	6	15	Ponce	46	38
Vega Alta	16	18	Peñuelas	15	-
Dorado	10	11	Guayanilla	34	2
Cataño	22	37	Guánica	66	6
San Juan	39	50	Lajas	63	39
Carolina	10	13	Sub-total	364	198
Loiza	10	13			
Rio Grande	27	25	West coast		
Luquillo	9	7	Cabo Rojo	159	4
Sub-total	211**	273	Mayaguez	53	58
			Añasco	40	3
East coast			Rincón	21	13
Fajardo	58	-	Aguada	39	4
Ceiba	16	23	Aguadilla	82	131
Naguabo	43	22	Sub-total	394	213
Humaco	72	30			
Yabucoa	19	41			
Maunabo	14	4			
Cúlebra	44	47			
Vieques	27	69			
Subtotal	293**	236			
Grand Total				1,262	920

Puerto Rican officials refer to these fishermen as commercial because they market their catch.
* Total number of full-time artisanal fishermen. The number deploying longlines are a small fraction. This data is presented as a guide to the overall importance of the port.
** While the north and east coasts have the smaller number of full-time fishermen, they have the largest number of part-time fishermen.
Note: Data on other gear types is available in the source. Locations of municipalities detailed in attached map.
Source: Daniel Matos-Caraballo, "Puerto Fishery census, 1995-96," submitted to the Gulf and Caribbean Fisheries Institute for publication, November 9, 1998. Attached map from Puerto Rican Departamento de Agricultura publications.



Appendix C2a.--Puerto Rico. Fisheries summary, 1972-78

Coast	Catch	Species*	Gear
	Percent		
North	9	Deepwater snapper	Bottom line/troll line
		Sierra king mackerel	
		Yellowtail snapper	
South	25	Grunt/grouper/lobster	Traps
East	20	Grunt/grouper/lobster	Traps
West	46	Grunt/grouper	Traps/bottom line
		Deepwater snapper	

Source: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 9.

Appendix C2b.--Puerto Rico. Fisheries summary, 1979-82

Coast	Catch	Gear
	Percent	
North	9	Traps/bottom line
South	26	Traps
East	16	Traps
West	49	Traps/bottom line

Source: José Collazo y José Calderón, "La pesca en Puerto Rico, 1979-82," *CODREMAR Informe Técnico*, Vol. 1, No. 2, 1988, pp. 22-24.

Appendix C2c.--Puerto Rico. Fisheries summary, 1983-87

Coast	Catch	Species*	Gear
	Percent		
North	12	Deepwater snapper	Bottom line/troll line
		Sierra (king mackerel)	
		Yellowtail snapper	
South	22	Queen conch	Diving
		Grunt/grouper/lobster	Traps
East	14	Grunt/grouper/lobster	Traps
West	52	Queen conch	Diving
		Tuna, Sierra	Troll line
		Grunt/grouper/snapper	Traps/bottom line
		Deepwater snapper	

Source: Daniel Matos Caraballo and Carolyn Rivera Alvarez, "Perspectiva de las estadisticas de pesca de pequeña escala en Puerto Rico, 1983-87," *CODREMAR Informe Técnico*, Vol. 1, No. 3, 1994, pp. 10-14.

Appendix C2d.--Puerto Rico. Fisheries summary, 1988-89

Coast	Catch	Species*	Gear
	Percent		
North	10	Deepwater snapper	Bottom line/troll line
		Sierra (king mackerel)	
		Yellowtail snapper	
South	24	Queen conch	Diving
		Grunt/grouper/lobster	Traps
East	16	Queen conch	Diving
		Grunt/snapper/lobster	Traps
		Mackerel	Troll line
West	50	Queen conch	Diving
		Tuna, dorado, Sierra	Troll line
		Deepwater snapper	Bottom line

Source: Daniel Matos Caraballo, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, pp. 12-15.

Appendix C3a.--Puerto Rico. Fishing gear, operating units, 1972-78, 1980, 1982

Gear		Year								
English	Spanish	1972	1973	1974	1975	1976	1977	1978	1980	1982
						Units				
Gear										
Beach seine	Chinchorro	110	147	310	254	NA	213	238	148	226
Trap	Nasa	8,029	8,260	7,687	8,191	NA	9,743	12,586	19,165	23,571
Lobster trap	Cajón	76	363	890	861	NA	1,660	2,252	1,916	2,599
Gill net	Trasmallo	50	359	325	306	NA	529	870	693	906
Line	Cordel	994	1,353	1,164	972	NA	2,584	2,391	1,717	1,870
Troll line	Silga	1,165	1,115	926	802	NA	1,518	2,057	1,189	1,840
Trot line	Palangre	193	203	178	201	NA	261	331	325	404
Pole	Vara	76	51	45	133	NA	51	23	*	*
Cast net	Atarraya	576	561	493	478	NA	715	827	*	*
Spear	Fisga/figa	135	157	108	141	NA	212	341	190	310
Other	Otros	NA	NA	NA	NA	NA	NA	NA	657	684
Fishermen**		970	930	1,120	1,230	NA	1,368	1,442	1,447	1,872

NA - Not available
* Included under "Other"
** Full and part time fishermen
Sources: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 15, and José Collazo y José Calderón, "La pesca en Puerto Rico, 1979-82," *CODREMAR Informe Técnico*, Vol. 1, No. 2, 1988, pp. 22-24.

Appendix C3b.--Puerto Rico. Landings by main fishing gear, 1983-89

Gear		Year						
English	Spanish	1983	1984	1985	1986	1987	1988	1989
		1,000 pounds						
Nets								
Beach seine	Chinchorro	213	139	99	94	125	93	101
Gill net	Trasmallo	414	331	362	370	333	273	222
Cast net	Atarraya	16	18	19	14	20	6	9
Subtotal		643	488	480	478	478	372	332
Traps								
Fish	Nasa	1,562	1,406	1,069	941	772	597	832
Lobster	Cajón	18	24	135	19	16	18	19
Subtotal		1,580	1,430	1,204	960	788	615	851
Lines								
Hand	Cordel/cala	426	355	568	651	417	419	543
Troll	Silga	411	202	170	199	178	242	242
Trot	Palangre	30	22	22	11	12	25	29
Subtotal		867	579	760	861	607	686	814
Diving	Buceo	837	610	365	367	277	398	302
Other	Otros	2	48	31	2	2	4	5
Total*		3,930	3,155	2,839	2,667	2,149	2,076	2,305

* Total may not agree due to rounding
Note: The discrepancy with FAO catch data in appendix D1a is unexplained.
Sources: Daniel Matos Caraballo and Carolyn Rivera Alvarez, "Perspectiva de las estadisticas de pesca de pequeña escala en Puerto Rico, 1983-87," *CODREMAR Informe Técnico*, Vol. 1, No. 3, 1994, pp. 21-30, and Daniel Matos Caraballo, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, pp. 14-15.

Appendix C3c.--Puerto Rico. Landings by main fishing gear, proportion 1983-89

Gear	Year						
	1983	1984	1985	1986	1987	1988	1989
	Percent						
Traps	40	45	42	36	37	30	37
Lines	22	18	27	32	28	33	35
Nets	16	15	17	18	22	18	14
Diving	21	19	13	14	13	19	13
Other	Negl	Negl	2	1	Negl	Negl	Negl

Note: The discrepancy with FAO catch data in appendix D1a is unexplained.
Sources: Daniel Matos Caraballo and Carolyn Rivera Alvarez, "Perspectiva de las estadisticas de pesca de pequeña escala en Puerto Rico, 1983-87," *CODREMAR Informe Técnico*, Vol. 1, No. 3, 1994, pp. 21-30, and Daniel Matos Caraballo, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, pp. 14-15.

Appendix D1a.--Puerto Rico. Fisheries catch, 1980-99

Year	Catch
	Metric tons
1980	2,557
1981	1,784
1982	2,202
1983	2,655
1984	2,354
1985	1,496
1986	1,327
1987	1,191
1988	1,697
1989	1,953
1990	2,062
1991	2,115
1992	1,545
1993	1,552
1994	1,924
1995	2,516
1996	2,311
1997	2,634
1998	2,118
1999	2,107

Note: There are substantial variations in the catch reported by FAO and the catch reported by NMFS in *Fisheries of the United States*. One factor is the differing treatment of shellfish shells.
Source: FAO, *Yearbook of Fishery Statistics*, various years.

Appendix D1b.--Puerto Rico. Fisheries catch, 1978

Species	Coast				Total*
	North	South	East	West	
		Metric tons			
Principal species					
Grouper	16	108	112	146	381
Grunts	5	132	85	260	482
Lobster	5	67	52	80	205
Snappers	64	191	83	287	625
Oceanic pelagics					
Dorado	4	9	1	9	22
Marlin, blue	3	Negl	Negl	1	4
Mackerel	25	52	27	29	133
Tunas	27	2	4	41	74
Other	149	223	191	419	982
Total	298	784	557	1,271	2,908

* Totals may not agree due to rounding
Note: The source authors estimate the above statistics represent about 91 percent of the actual catch.
Source: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 21.

Appendix D1c.--Puerto Rico. Pelagic and total fishery landings, 1978-89

Year*	Fishery		Total	Proportion pelagic
	Pelagic**	Demersal***		
	Metric tons			Percent
1978	233	2,629	2,862	8
1979	218	3,002	3,220	7
1980	284	2,693	2,977	10
1981	329	2,307	2,636	12
1982	287	2,133	2,420	12
1983	205	1,549	1,754	12
1984	107	1,302	1,409	8
1985	99	1,169	1,268	8
1986	85	1,106	1,191	7
1987	104	855	959	11
1988	141	786	927	15
1989	137	892	1,029	13

NA - Not available
* The landings entered in this table are only partial data, with varying coverage: 1978 - 91 percent, 1979-82 - 100 percent; 1983-87 - 75 percent; and 1988-89 - 56 percent.
** A species breakdown of the pelagic catch is available in the D2 appendix series.
*** Demersal and other fisheries.
Sources: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 21 (1978 data); José Collazo y José Calderón, "La pesca en Puerto Rico, 1979-82," *CODREMAR Informe Técnico*, Vol. 1, No. 2, 1988, pp. 22-24. (1979-82 data); Daniel Matos Caraballo and Carolyn Rivera Alvarez, "Perspectiva de las estadísticas de pesca de pequeña escala en Puerto Rico, 1983-87," *CODREMAR Informe Técnico*, Vol. 1, No. 3, 1994, pp. 21-30 (1983-87 data); and Daniel Matos Caraballo, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, pp. 14-15 (1988-89 data).

Appendix D1d.--Puerto Rico. Landings by coast/port, 1994-97

Coast	Year			
	1994	1995	1996	1997
	Metric tons			
North	173	253	174	218
East	152	311	307	331
South	356	489	521	556
West				
Cabo Rojo	350	383	367	366
Mayagüez	50	50	66	55
Añasco	13	16	21	16
Rincón	38	40	42	81
Aguada	40	45	44	77
Aguadilla	54	95	98	139
Total, west	550	629	638	661
Total	1,231	1,682	1,641	1,767

Source: Source: Daniel Matos Caraballo, "Overview of Puerto Rico's small-scale fisheries statistics, 1994-97," paper submitted to GCFI, November 9, 1998.

Appendix D2a.--Puerto Rico. Fisheries oceanic pelagic catch, by gear 1978

Species	Gear			Total*
	Beach seine	Troll	Gill net	
	Metric tons			
Dorado	-	22	-	22
Marlin, blue	-	4	-	4
Mackerel	9	120	5	133
Tunas	23	51	-	74

* Totals may not agree due to rounding
Note: The source authors estimate the above statistics represent about 91 percent of the actual catch.
Source: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, pp. 18-19.

Appendix D2b1.--Puerto Rico. Fisheries oceanic pelagic catch, 1978-89

Species	Year											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Metric tons*											
Dorado	22	19	38	27	25	19	7	9	15	13	31	31
Marlin, blue	4	8	12	15	7	NA	NA	NA	NA	NA	5	3
Mackerel	133	113	153	171	159	101	71	59	53	39	37	44
Tunas	74	78	81	116	96	85	29	31	37	52	65	59
Swordfish	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	-
Total**	233*	218	284	329	287	205	107	99	85	104	141	137

NA - Not available
* The landings entered in this table are only partial data, with varying coverage: 1978 - 91 percent, 1979-82 - 100 percent; 1983-87 - 75 percent; and 1988-89 - 56 percent.
** Totals may not agree due to rounding
Source: Deborah Weiler and José Suárez-Caabro, "Perspectiva de las estadísticas de la pesca en pequeña escala de Puerto Rico, 1972-78," *CODREMAR Informe Técnico*, Vol. 1, No. 1, 1986, p. 19, José Collazo and José Calderón, "La pesca en Puerto Rico, 1979-82," *CODREMAR Informe Técnico*, Vol. 1, No. 2, 1988, p. 29-30, Daniel Matos Caraballo and Carolyn Rivera Alvarez, "Perspectiva de las estadísticas de pesca de pequeña escala en Puerto Rico, 1983-87," *CODREMAR Informe Técnico*, Vol. 1, No. 3, 1994, p. 10-14, and Daniel Matos Caraballo and Ivonne Sadovy, "Perspectiva de las estadisticas de la pesca en pequeña escala de Puerto Rico, 1988-89," *CODREMAR Informe Técnico*, Vol. 1, No. 4, 1986, p. 10.

Appendix D2b2a.--Puerto Rico. Fisheries oceanic pelagic catch, 1972-79

Species	Year							
	1972	1973	1974	1975	1976	1977	1978	1979
	Metric tons							
Barracuda	21.3	23.1	11.6	17.3	16.4	28.4	32.0	30.7
Billfish								
Blue marlin	-#	-#	-#	-#	0.9	2.2	3.6	8.4
Sailfish	NA	NA	NA	NA	NA	NA	NA	NA
Dorado	8.4	3.6	4.0	8.9	8.4	7.6	21.8	18.7
Mackerel	86.7	68.0	53.3	55.6	84.4	95.1	130.2	112.4
Sharks	-	-	-	-	-	-	-	-
Swordfish	-	-	-	-	-	-	-	-
Tarpon	-	-	-	-	-	-	-	-
Tuna	72.4	47.6	40.9	60.9	65.8	53.3	72.9	77.8
Wahoo	-	1.8	-	-	-	-	-	-
Total	188.8	144.1	109.8	142.7	175.9	186.6	260.5	248.0

NA - Not available, believed to be minimal
As reported in source. The catch is unlikely to have been 0, this entry may mean not available.
Source: Richard Appeldoorn and Stephen Meyers, "Puerto Rico and Hispaniola," in "Marine Resources of the Antilles," *FAO Fisheries Technical Paper*, No. 326 (FAO: Rome, 1993), p. 129.

Appendix D2b2b.--Puerto Rico. Fisheries oceanic pelagic catch, 1980-89

Species	Year									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Metric tons									
Barracuda	43.1	27.6	7.6	12.0	5.8	4.9	8.0	12.0	6.2	7.6
Billfish										
Blue marlin	12.0	15.1	6.7	5.3	4.4	4.9	-#	11.1	4.9	2.7
Sailfish	NA	NA	NA	NA	NA	NA	NA	NA		
Dorado	37.3	26.6	24.4	19.1	6.7	9.8	14.2	12.9	31.1	31.1
Mackerel	152.0	170.1	158.7	107.5	76.9	68.0	51.1	41.8	36.9	43.6
Sharks	-	-	-	-	3.6	2.7	-	5.8	13.3	13.3
Swordfish	-	-	-	-	-	-	-	-		
Tarpon	-	-	-	-	-	-	-	-	1.8	2.1
Tuna	80.4	115.1	95.1	87.1	31.6	35.1	36.0	50.7	64.9	58.2
Wahoo	-	-	-	-	-	-	-	-		
Total	324.8	354.5	292.5	231.0	129.0	125.4	110.1	134.3	159.1	158.6

NA - Not available, believed to be minimal
As reported in source. The catch is unlikely to have been 0, this entry may mean not available.
Source: Richard Appeldoorn and Stephen Meyers, "Puerto Rico and Hispaniola," in "Marine Resources of the Antilles," *FAO Fisheries Technical Paper*, No. 326 (FAO: Rome, 1993), p. 129.

Appendix D2b2a.--Puerto Rico. Fisheries oceanic pelagic catch, 1978-89

Species	Year											
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Metric tons*											
Dorado	22	19	38	27	25	19	7	9	15	13	31	31
Marlin, blue	4	8	12	15	7	NA	NA	NA	NA	NA	5	3
Mackerel	133	113	153	171	159	101	71	59	53	39	37	44
Tunas	74	78	81	116	96	85	29	31	37	52	65	59
Swordfish	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	-
Total**	233*	218	284	329	287	205	107	99	85	104	141	137

NA - Not available
* The landings entered in this table are only partial data, with varying coverage: 1978 - 91 percent, 1979-82 - 100 percent; 1983-87 - 75 percent; and 1988-89 - 56 percent.
** Totals may not agree due to rounding
Source: Richard Appeldoorn and Stephen Meyers, "Puerto Rico and Hispaniola," in "Marine Resources of the Antilles," *FAO Fisheries Technical Paper*, No. 326 (FAO: Rome, 1993), p. 129.

Appendix D2c.--Puerto Rico. Oceanic pelagic catch, by species, 1994-97

Species	Year			
	1994	1995	1996	1997
	Metric tons			
Tunas	41	52	62	98
Dorado	41	90	69	76
Mackerel	55	86	76	93
Sharks	16	34	27	28
Total*	154	262	234	294

* Totals may not agree de to rounding.
Note: Gear data is available in appendices D2e1-2.
Source: Daniel Matos Caraballo, "Overview of Puerto Rico's small-scale fisheries statistics, 1994-97," paper submitted to GCFI, November 9, 1998.

Appendix D2d.--Puerto Rico. Selected commercial pelagic catch, by species, 1990-2000

Species	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Metric tons										
Barracuda			4.6		5.1	6.3	8.0	10.9	11.6	13.4	10.8
Billfish											
Marlin			2.3		0.9	-	-	-	-	-	-
Sailfish			-		-	-	-	-	-	-	-
Dorado			38.7		27.4	101.4	48.9	75.5	57.0	57.1	61.2
Mackerel			31.7		54.9	92.5	59.8	84.4	91.0	82.3	71.5
Shark			16.1		13.7	39.3	18.8	19.0	21.1	24.3	18.2
Swordfish			-		-	-	-	-	-	-	-
Tuna											
Skipjack			NA		4.1	NA	NA	NA	NA	NA	NA
Yellowfin			NA		8.3	NA	NA	NA	NA	NA	NA
Unclassified			31.8		11.3	61.3	76.1	90.4	60.4	87.4	61.3
Wahoo			-		1.1	-	-	-	-	-	-
Total*			125.2		126.8	300.8	211.6	280.1	262.7	264.5	223.0

* Totals may not agree due to rounding.
Source: NMFS, *Fisheries of the United States*, various years.

Appendix D2e1.--Puerto Rico. Oceanic pelagic catch, by gear and species, 1994

Species	Gear					Total
	Gillnet	Bottomline#	Troll-line	Longline	Other	
			Metric tons			
Tunas	0.2	5.8	31.5	Negl	3.7	41.2
Dorado	0.1	14.2	26.1	0.7	0.3	41.4
Mackerel	2.1	25.5	22.0	0.1	5.5	55.2
Sharks	2.4	9.7	1.3	0.9	2.1	16.4
Total	4.8	55.2	80.9	1.7	11.6	154.2

The bottom -line catch seems rather unusual for pelagic species.
Source: Daniel Matos Caraballo, "Overview of Puerto Rico's small-scale fisheries statistics, 1994-97," paper submitted to GCFI, November 9, 1998.

Appendix D2e2.--Puerto Rico. Oceanic pelagic catch, by gear and species, 1997

Species	Gear					Tuna
	Gillnet	Bottomline#	Troll-line	Longline	Other	
			Metric tons			
Tunas	1.9	13.9	68.2	0.6	13.6*	98.2
Dorado	0.8	14.7	57.7	Negl	2.5	75.7
Mackerel	13.2	46.7	23.9	0.1	8.5	92.4
Sharks	3.9	12.7	0.8	5.5	4.9	27.8
Total	19.8	88.0	150.6	6.2	29.5	294.1

* Mostly beach seine
# The bottom -line catch seems rather unusual for pelagic species.
Source: Daniel Matos Caraballo, "Overview of Puerto Rico's small-scale fisheries statistics, 1994-97," paper submitted to GCFI, November 9, 1998.

Appendix D3a.--Puerto Rico. Swordfish catches, 1984-2000

Year	Domestic			Mainland U.S.
	PRF**	FAO#	ICCAT##	Catch*
			Metric tons	
1984***		-	NA	26.7
1985***		-	NA	357.7
1986***		-	NA	1,117.6
1987		-	NA	827.6
1988		-	NA	424.7
1989		-	NA	193.3
1990		-	NA	327.7
1991		-	NA	329.9
1992		-	NA	325.3
1993		-	NA	306.1
1994		-	NA	444.6
1995		-	NA	917.3
1996		-	NA	894.1
1997		-	NA	793.0
1998		-	NA	438.4
1999		-	NA	244.7
2000		-	NA	118.0

NA - Not available.
* Converted to live weight using a conversion factor of 1.4. Virtually all of the catch of the mainland U.S. vessels is shipped on to mainland U.S. markets.
** Provided by various Puerto Rican fishery agencies.
*** First U.S. longline catches reported for the Caribbean region during December 1984. The United States instituted mandatory reporting of fishing locations during mid-1986. Data was previously (1984-86) compiled from voluntary reporting of fishing locations and may not as accurately reflect first port of landings totals available in more recent
years (1987-2000).
Marine fish are not broken down by species
ICCAT does not report separate U.S. data for Puerto Rico.
Source: CARICOM, "Report of the CARICOM Resource Assessment and Management Program (CFRAMP)," (SCRS/98/102) (PRF data); *Yearbook of Fishery Statistics*, various years (FAO data); ICCAT, *Statistical Bulletin*, various years and various ICCAT-SCRS releases (ICCAT data); NMFS Southeast Fisheries Center (U.S. catch data); and U.S. Bureau of the Census (U.S. Import data).

Appendix D3b.--Puerto Rico. Swordfish landings of mainland U.S. fishermen, 1984-2000

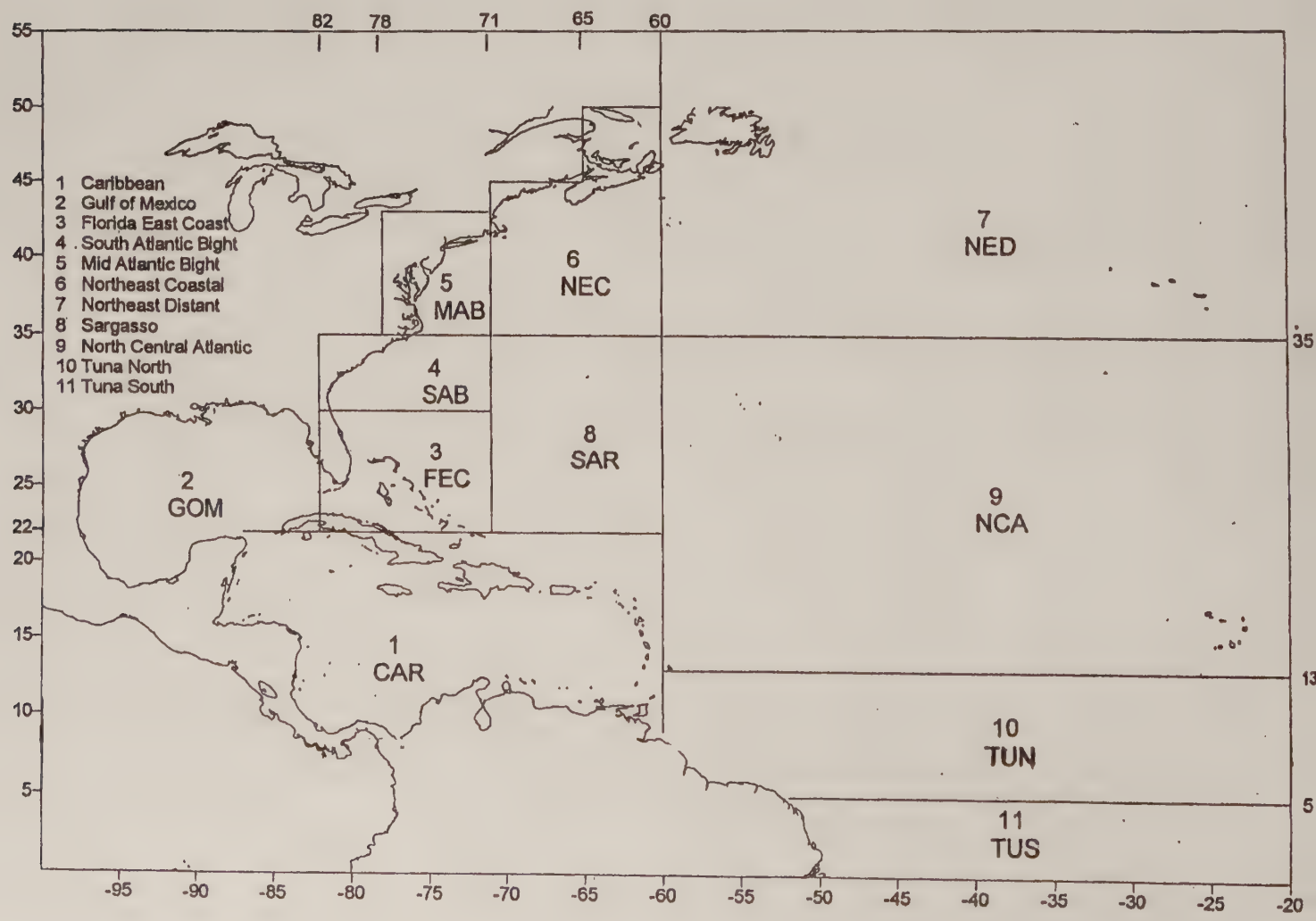
Year	Quantity	
	Product*	Live-weight
	Metric tons	
1984**	18.1	26.7
1985**	250.4	357.7
1986**	782.3	1,117.6
1987	579.3	827.6
1988	297.3	424.7
1989	135.3	193.3
1990	229.4	327.7
1991	230.9	329.9
1992	227.7	325.3
1993	214.3	306.1
1994#	311.2	444.6
1995	642.1	917.3
1996	625.9	894.1
1997	555.1	793.0
1998	306.9	438.4
1999	171.3	244.7
2000	82.6	118.0

NA - Not available
* Mostly trunks
** First U.S. longline catches reported for the Caribbean region during December 1984. The United States instituted mandatory reporting of fishing locations during mid-1986. Data was previously (1984-86) compiled from voluntary reporting of fishing locations and may not as accurately reflect first port of landings totals available in more recent years (1987-2000).
# Beginning in 1994, the landings data is available showing where the fish was caught (appendix D3c).
Source: Southeast Fisheries Science Center

Appendix D3c.--Puerto Rico. Swordfish landings of mainland U.S. fishermen, by catch area, ~~1984~~-2000

Year	Area#						Total
	Florida	Caribbean*	Sargasso	NCentAtl	Tuna-North	Tuna-South	
			Metric tons				
1984	-	18.1	NA	NA	NA	NA	18.1
1985	-	250.4	NA	NA	NA	NA	250.4
1986	-	782.4	NA	NA	NA	NA	782.4
1987	-	579.4	NA	NA	NA	NA	579.4
1988	-	297.3	NA	NA	NA	NA	297.3
1989	-	135.3	NA	NA	NA	NA	135.3
1990	-	229.4	NA	NA	NA	NA	229.4
1991	-	230.9	NA	NA	NA	NA	230.9
1992	-	227.7	NA	NA	NA	NA	227.7
1993	-	214.3	NA	NA	NA	NA	214.3
1994	4.8	306.5	NA	NA	NA	NA	311.2
1995	-	642.1	NA	NA	NA	NA	642.1
1996	-	183.2	3.1	226.9	100.4	112.4	625.9
1997	-	86.5	6.1	190.4	41.9	230.1	555.1
1998	-	23.9	2.3	175.0	19.6	86.1	306.9
1999	-	17.4	5.4	57.7	9.6	81.2	171.3
2000	-	25.4	-	46.9	0.5	9.8	82.6

NA - Until 1996, all the U.S. catch in the wider-Caribbean was just classified as "Caribbean".
* Mostly trunks
# See map attached here for area details.
Source: Angelo Bertolino, NMFS Southeast Fisheries Science Center



Appendix D3d.--United States. Swordfish landings at domestic Caribbean sites*, 1984-2000

Year	Puerto Rico	Virgin Islands	Florida ports*	Total
	Metric tons			
1984**	18.1***	-	-	18.1***
1985**	250.4	-	5.3	255.7
1986**	782.4	38.1	8.9	829.4
1987	579.4	148.8	45.8	774.0
1988	297.3	231.9	81.2	610.4
1989	135.3	92.9	73.1	301.3
1990	229.4	0.2	79.0	308.6
1991	230.9	0.4	236.3	467.6
1992	227.7	4.5	183.3	415.5
1993	214.3	13.2	298.0	525.5
1994	311.2	132.0	215.7	658.9
1995	642.1	121.9##	244.9	1,008.9
1996	625.9	23.4	176.1	825.4
1997	555.1	29.3	147.4	731.8
1998	306.9	8.8	138.4	454.1
1999	171.3	9.0	78.7	259.0
2000	82.6	-	163.5	246.1

Note: Not all Caribbean-caught swordfish by U.S. fishermen can be assigned to a specific port of first landing. The above totals, although not complete, represent a high proportion (80 percent or more) of the reported U.S. Caribbean region swordfish catch. Details on U.S. landings in foreign Caribbean ports are available in Caribbean Overview appendix E1.

* Some swordfish taken in the Caribbean-region may be landed in Miami or other, mostly Florida, U.S. ports (appendix D3d)

** First U.S. longline catches reported for the Caribbean region during December 1984. The United States instituted mandatory reporting of fishing locations during mid-1986. Data was previously (1984-86) compiled from voluntary reporting of fishing locations and may not as accurately reflect first port of landings totals available in more recent years (1987-2000).

*** Unconfirmed reports suggest that actual landings could have exceeded 450 tons.

Caribbean ports

Hurricane Marilyn adversely affected Virgin Islands landings beginning in September 1995.

Source: Angelo Bertolino, NMFS, Southeast Fisheries Science center, Computer data runs.

Appendix D3e.--United States. Swordfish landings at Florida ports* by catch area, 1984-2000

Year	Catch area		Total
	Caribbean	Other#	
	Metric tons		
1984**	-***	-	-***
1985	5.3	-	5.3
1986	8.9	-	8.9
1987	45.8	-	45.8
1988	81.2	-	81.2
1989	73.1	-	73.1
1990	79.0	-	79.0
1991	236.3	-	236.3
1992	183.3	-	183.3
1993	298.0	-	298.0
1994	215.7	-	215.7
1995##	244.9	-	244.9
1996	148.5	27.6###	176.1
1997	139.7	7.7###	147.4
1998	138.4	-	138.4
1999	73.1	5.6####	78.7
2000	163.5	-	163.5

Note: Not all Caribbean-caught swordfish by U.S. fishermen can be assigned to a specific port of first landing. The above totals, although not complete, represent a high proportion (80 percent or more) of the reported U.S. Caribbean region swordfish catch. Details on U.S. landings in foreign Caribbean ports see Caribbean Overview, appendix E1.

* Some swordfish taken in the Caribbean-region may be landed in Miami or other, mostly Florida, U.S. ports (appendix D3d)

** First U.S. longline catches reported for the Caribbean region during December 1984. The United States instituted mandatory reporting of fishing locations during mid-1986. Data was previously (1984-86) compiled from voluntary reporting of fishing locations and may not as accurately reflect first port of landings totals available in more recent years (1987-95).

*** Unconfirmed reports suggest that actual landings could have exceeded 450 tons.

See map with appendix D3c for a description of the fishing areas.

Hurricane Marilyn adversely affected Virgin Islands landings beginning in September 1995.

All or mostly in the Sargasso Sea.

Mostly in the North Central Atlantic.

Source: Angelo Bertolino, NMFS, Southeastern Fisheries Science Center, Computer data runs.

Appendix D4a.--Puerto Rico. Recreational oceanic pelagic catch by species, 2000*

Species	Individual fish	Precision (PSE)
	Number	
Billfish		
Blue marlin	10,236	26.1
Longbill spearfish	357	89.2
Sailfish	578	93.3
White marlin	1,489	56.8
Yellowfin tuna	1,244	68.8
Bonito	1,003	65.5
Sharks		
Large coastal	11,131	68.8
Small coastal	629	70.7
Swordfish	-	-
Tuna		
Albacore	2,694	100.2
Bigeye	1,057	99.0
Skipjack	2,334	57.4

PSE - The proportional standard error expresses the standard error of these estimates as a percentage of the estimate. The larger the number, the greater the possible error. The large numbers noted here indicate that NMFS has little confidence in these preliminary estimates. Even the estimate 26 PSE for blue marlin is a relatively high number.
* The MRFSS was first extended to Puerto Rico in 2000.
Source: NMFS, Marine Recreational Fisheries Statistics Survey (MRFSS): http://www.st.nmfs.gov/st1/recreational/queries/custom/tsb.html

Appendix D4b.--Puerto Rico. Recreational oceanic pelagic effort by month, ocean area, and type, 2000*

Ocean area/ Type	Month						Total
	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	
	1,000 Trips*						
Inland							
Shore	10.5	125.7	95.5	159.0	64.7	134.6	590.1
Private/rental	0.7	5.8	3.7	7.5	3.0	5.8	26.4
Charter	-	0.4	-	0.1	0.1	-	0.6
Ocean (<10 miles)							
Shore	21.4	28.7	21.7	29.3	30.6	3.6	135.2
Private/rental	25.3	38.6	86.1	66.0	65.1	70.1	351.2
Charter	-	2.3	-	5.2	4.9	-	12.4
Ocean (>10 miles)							
Private/rental	29.9	25.1	9.1	8.6	8.9	41.8	123.3
Charter	-	1.0	-	0.1	-	-	1.1
Total	87.8	227.6	216.1	275.8	177.3	255.9	1,240.2**

PSE - The proportional standard error expresses the standard error of these estimates as a percentage of the estimate. The larger the number, the greater the possible error. The effort PSE are much smaller than those available for catch (appendix D4a). This indicates that NMFS has more confidence in these preliminary effort estimates than the catch estimates. For organizational simplicity, the PSEs are not included here, but are available in the source. As with the species data above, many of the entries have PSEs which suggest a high possibility of error.
* Preliminary data
** The MRFSS was first extended to Puerto Rico in 2000.
*** Totals may not agree due to rounding.
Source: NMFS, Marine Recreational Fisheries Statistics Survey (MRFSS): http://www.st.nmfs.gov/st1/recreational/queries/custom/tsb.html

Appendix D5.--ICCAT area 1565. Foreign swordfish catches by country and quarter, 1959-97

Country	Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
		Metric tons				
Cuba	No fishing activity reported					
Japan	1962		1.8	1.2		3.0
	1963		0.2	5.8	3.5	9.5
	1964		6.6	0.2		6.8
	1965		0.4	0.4		0.8
	1966		0.6	10.5	3.0	14.1
	1967			0.1	0.1	0.2
	1968		0.1	0.3		0.4
	1969			0.1		0.1
	1971	0.3		1.6	0.6	2.5
	1973			0.2		0.2
	1974			0.2	0.5	0.7
	1976		0.2			0.2
	1977			0.1		0.1
	1986			0.1		0.1
Korea	1978			0.6	4.5	5.1
	1979	2.0	2.7	6.9	11.7	23.3
	1980		0.5			0.5
	1981			0.2	0.3	0.5
	1985			3.4		3.4
Spain	No fishing activity reported					
Taiwan	1968	3.2	0.2		6.6	10.0
	1969	0.6			1.1	1.7
	1970				0.3	0.3
	1972			0.6		0.6
	1974		0.7		2.5	3.2
	1975		3.5	1.1	0.4	5.0
	1976			1.4		1.4
	1977			1.8	3.1	4.9
	1980				0.3	0.3
	1982		0.3		0.6	0.9
United States	U.S. fishing data unavailable**					

* ICCAT square are 5° degree squares of latitude and longitude. The first two numbers are the latitude and the second two numbers are the longitude. This represents the southeastern corner of the 5° square for catches in quadrant 4, northwest Atlantic.
** The authors encountered apparent statistical problems with the U.S. data on the ICCAT web site. Apparently ICCAT is in the process of recalculating the 1° square data by 5° squares. As a result this data was not added to this appendix.
Source: ICCAT: http://www.iccat/es/Stats.html, retrieved July 3, 2000

Appendix E1.--Puerto Rico. Seafood consumption, 1998

Source/ commodity	Quantity	Supplier
	1,000 Metric tons*	
Domestic	2.5	
Import#		
Cod	9.1	Canada, France, and Spain
Other	20.4	United States**
Total	32.2***	

* Product weight
** Primarily the Gulf of Mexico, may include some Mexican product
*** Totals may not agree due to rounding
# Partial import data available in appendix F1a.
Source: Miguel Rolón, Executive Director, Caribbean Fisheries Management Council, personal communications, April 15, 1999.

Appendix E2a.--Puerto Rico/Virgin Islands. Swordfish dealer permits, 1995-2001

Permitted dealers	Longline species*	Years	Handling facilities
Puerto Rico			
Fresh Fish Company	Sh and Sd	1999-2000	Rio Piedras, Puerto Rico
Thomas Forte	Sh and Sd	1998-2000	Cataño, Puerto Rico
U.S. Virgin Islands			
Caribbean Seafood Industries	Sd	1995	Crown Bay, St. Thomas
McAuliffe Fishing	Sh and Sd	1995-2001	Gallows Bay, St. Croix
S&P Seafoods	Sh and Sd	1999-2000	Crown Bay, St. Thomas

* Species key
Sh - Shark
Sd - swordfish
Source: Southeast Region (F/SER), NMFS.

Appendix E2b.--Puerto Rico. Tuna dealer permits, 2001

Permitted dealers	Handling facilities
Asociación de Pesca Bo Jar	Arecibo
Fresh Fish Company	Rio Piedras
(La) Mercedith	Aguadilla
Pescadería Rincón	Rincón
(La) Pescadería	Rincón
Pescadería Ambulante	Aguada
Pescadería Plaza	Aguadilla
Rios Irrizary, Rafael	Aguada
Vendedor Ambulante	Aguadilla

Source: Northeast Region (F/SER), NMFS.

Appendix E3.--United States. Swordfish landings, value, and prices, 1985-2000

Year	U.S. Landings*	U.S. Value	U.S. apparent prices		Mass. apparent prices	
			Whole	Product**	Whole	Product
	Metric tons	US$1,000	US$/kg			
1985	7,256.5	35,507.2	4.89	6.99	5.30	7.57
1986	5,558.4	32,344.8	5.82	8.31	6.81	9.73
1987	5,647.7	41,852.4	7.41	10.58	7.25	10.36
1988	6,745.7	48,348.0	7.16	10.23	6.48	9.26
1989	6,801.4	46,169.9	6.78	9.69	6.43	9.19
1990	6,992.7	44,705.3	6.39	9.13	6.41	9.16
1991	8,582.8	51,184.1	5.96	8.51	6.35	9.07
1992	9,646.9	59,861.4	6.20	8.86	6.01	8.59
1993	10,850.8	55,200.5	5.08	7.26	6.01	8.59
1994	7,407.4	42,517.8	5.73	8.19	6.52	9.31
1995	6,268.1	35,475.6	5.66	8.09	5.82	8.31
1996	6,110.4	35,476.6	5.81	8.30	6.60	9.43
1997	6,497.1	33,489.1	5.15	7.36	4.90	7.00
1998	6,832.2	28,791.6	4.21	6.01	4.16	5.94
1999	7,455.5	33,670.2	4.52	6.46	5.07	7.24
2000	7,962.5	37,579.8	4.71	6.73	5.50	7.86

Note: No data is available on prices received for the swordfish shipped from San Juan. This data is the U.S. national aggregate. Prices for swordfish in Massachusetts, where a lot of the swordfish shipped from San Juan was marketed, tended to be higher, but were also occasionally lower. An additional $0.50-0.75 was not unusual and the difference at times approached as much as $1.00 in whole prices and even more in product weight prices. In other years the Massachusetts prices were close to the aggregate U.S. prices.

* Expressed in round (whole) weight

** Most U.S. longline fishermen land swordfish as trunks (headed and gutted). The authors have calculated the approximate product weight to facilitate comparisons with imported product. We have use 70 percent as the approximate conversion equivalent.

Source: NMFS. "Commercial fisheries: Annual landing statistics," internet site accessed September 13, 2001: http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html

Appendix F1a.--Puerto Rico. Puerto Rico. Seafood imported through the San Juan Customs District, 1990-2000

Year	Import quantity		
	All seafood	Frozen tuna*	Balance**
	1,000 Metric tons		
1990	148.6	135.1	13.5
1991	152.7	142.8	9.9
1992	126.3	116.8	9.5
1993	135.1	124.3	10.8
1994	136.7	125.3	11.4
1995	150.7	138.2	12.5
1996	159.5	146.4	13.1
1997	122.5	109.7	12.8
1998	154.8	142.3	12.5
1999	104.3	90.8	13.5
2000	88.7	73.2	15.5

Note: This appendix does not provide a complete assessment of seafood not produced on the island. It does not include seafood entering the United States through other customs district and seafood purchased from the mainland United States. See appendix E1 for an estimated overall assessment. Details on trade between the mainland United States and Puerto Rico is available at: http://www.census.gov/prod/www/abs/ftdpr895.html
* Most of the frozen tuna imported is canned and then shipped off the island, largely to mainland U.S. markets (appendix F3b).
** The imports excluding frozen tuna give a better idea of foreign seafood actually consumed in Puerto Rico. They do not, however, include seafood purchased in the U.S. mainland.
Source: U.S. Bureau of the Census.

Appendix F1b.--Puerto Rico. Seafood imported through the San Juan Customs District, 1990-2000

Year	Value		
	All seafood	Frozen tuna*	Balance**
	US$ million		
1990	211.8	182.2	29.6
1991	194.4	164.8	29.6
1992	216.6	185.9	30.7
1993	239.1	209.7	29.4
1994	244.2	207.2	37.0
1995	283.1	238.9	44.2
1996	303.0	260.6	42.4
1997	265.2	222.0	43.2
1998	282.9	237.2	45.7
1999	244.0	198.3	45.7
2000	231.6	181.8	49.8

Note: This appendix does not provide a complete assessment of seafood not produced on the island. It does not include seafood entering the United States through other customs district and seafood purchased from the mainland United States. Details on trade between the mainland United States and Puerto Rico is available at: http://www.census.gov/prod/www/abs/ftdpr895.html
* Most of the frozen tuna imported is canned and then shipped off the island, largely to mainland U.S. markets (appendix F3b).
** The imports excluding frozen tuna give a better idea of foreign seafood actually consumed in Puerto Rico. They do not, however, include seafood purchased in the U.S. mainland.
Source: U.S. Bureau of the Census.

Appendix F2a.--Puerto Rico/U.S. Virgin Islands. Swordfish imports

Customs area/ Commodity	Year											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001#
	Metric tons											
Puerto Rico												
Fresh	-	-	-	-	-	-	-	-	-	-	-	-
Frozen	-	2.4	-	-	-	-	-	13.1*	-	-	37.8*	36.4***
Total	-	2.4	-	-	-	-	-	13.1	-	-	37.8	36.4
U.S. Virgin Islands												
Fresh	-	-	0.9**	-	-	-	-	-	-	-	-	-
Frozen	-	1.4	0.6	-	-	-	-	-	-	-	-	-
Total	-	1.4	1.5	-	-	-	-	-	-	-	-	-

* Fillets or mostly fillets
** From Antigua
*** Fillets from Ecuador
# Through June
Source: U.S. Bureau of the Census

Appendix F2b.--United States. Swordfish imports, 1990-2000

Year	Imports	
	Quantity	Value
	Metric tons	US$Million
1990	7,475.6	39.0
1991	7,170.9	42.1
1992	6,882.6	42.8
1993	5,838.1	39.0
1994	4,379.1	30.2
1995	4,681.3	31.9
1996	5,139.6	32.9
1997	15,598.1	95.4
1998	16,281.8	82.6
1999	13,843.0	71.7
2000	14,314.1	85.6

Source: U.S. Bureau of the Census

Appendix F2c.--United States. Swordfish imports from Spain, 1995-2000

Year	Imports	
	Quantity	Value
	Metric tons	US$Million
1995	-	-
1996	13.6	0.09
1997	4.1	0.04
1998	6.5	0.02
1999	-	-
2000	0.5	0.01

Source: U.S. Bureau of the Census

Appendix F3a.--Puerto Rico. Frozen tuna imports through the San Juan Customs district, 1990-2000

Commodity	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	1,000 Metric tons										
Albacore	47.6	41.3	57.1	60.1	57.7	59.9	56.2	55.0	52.2	59.0	48.0
Bluefin	-	-	-	-	-	-	0.1	-	-	-	-
Skipjack	61.9	65.1	44.4	42.9	37.9	49.1	46.2	27.4	47.8	7.7	0.7
Yellowfin											
Eviscerated	0.5	0.1	Negl	-	Negl	-	-	-	-	-	-
Whole	17.9	26.5	5.2	12.1	19.4	13.5	20.4	10.1	25.1	5.1	0.4
Other											
Other	1.1	2.1	1.3	2.0	2.3	2.0	3.4	0.9	0.4	-	0.7
Loins	6.1	7.7	8.8	7.2	8.0	13.7	20.1	16.3	16.8	19.0	23.4
Total	135.1	142.8	116.8	124.3	125.3	138.2	146.4	109.7	142.3	90.8	73.2

Source: U.S. Bureau of the Census

Appendix F3b.--Puerto Rico. Frozen tuna imports through the San Juan Customs district, 1990-2000

Commodity	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	US$ Million										
Albacore	99.3	77.3	132.3	152.8	140.3	143.3	133.9	134.2	117.2	130.6	120.3
Bluefin	-	-	-	-	-	-	0.1	-	-	-	-
Skipjack	55.4	47.0	31.5	29.8	28.6	44.6	42.5	29.2	43.3	5.5	2.2
Yellowfin											
Eviscerated	0.5	0.1	0.1	-	Negl	Negl	-	-	-	-	-
Whole	15.4	22.6	4.2	10.0	17.7	15.3	27.0	15.0	33.8	6.0	1.2
Other											
Other	1.7	1.8	1.0	1.7	Negl	2.1	5.1	1.4	0.5	-	2.3
Loins#	9.9	16.0	16.8	15.4	20.6	33.6	52.0	42.2	42.3	56.2	55.8
Total	182.2	164.8	185.9	209.7	207.2	238.9	260.6	222.0	237.1	198.3	181.8

When calculating the live weight and relative importance of these shipments it should be noted that loins are more important than the actual quantity suggests. The lice weight conversion ration is about 2.25.
Source: U.S. Bureau of the Census

Appendix F4.--Puerto Rico. Frozen albacore imports through the San Juan Customs district, 1990-2000

Country	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	1,000 Metric tons										
Japan	8.4	4.3	11.3	12.0	9.9	8.3	8.5	12.4	7.9	7.2	3.3
Mauritius	1.6	1.2	Negl	-	-	1.1	4.1	4.1	2.2	-	4.4
Neth. Antilles*	-	-	-	-	0.4	2.7	5.7	7.5	7.9	6.6	5.8
Panama	2.6	1.3	1.9	0.1	-	0.1	-	-	-	-	-
South Africa	-	-	5.3	7.0	7.3	7.5	5.4	3.3	3.1	4.5	2.7
Spain	-	1.0	1.8	1.0	0.6	0.3	Negl	Negl	-	-	-
Taiwan	32.7	28.9	33.8	35.8	38.1	31.5	26.8	26.4	28.9	38.4	27.9
Uruguay**	Negl	0.3	0.3	Negl	-	Negl	-	Negl	0.6	Negl	3.1
Other	2.3	4.3	2.7	4.2	1.4	8.4	5.7	1.3	1.6	2.3	0.8
Total	47.6	41.3	57.1	60.1	57.7	59.9	56.2	55.0	52.2	59.0	48.0

Negl - Negligible
* St. Maarten, mostly Taiwan-caught fish
** Transhipment point
Source: U.S. Bureau of the Census

Appendix G1a.--United States. Estimated fish catch in longline fishing effort, 1993

Area	Species		Individuals*	Kept	Discarded		Catch share
	Common Name	Scientific Name			Dead	Alive	
			Number	Percent			
Caribbean							
	Swordfish	Xiphias gladius	16,887	0.86	0.09	0.05	49.50
	Dolphin fish	Coryphaenidae	3,865	0.83	0.01	0.16	11.36
	Lancetfish	Alephisauridae	2,716	0.88	0.88	0.12	7.96
	Escolar	Lepidocybium flavobrunneum	2,072	0.50	0.33	0.17	6.07
	Blue shark	Prionace glauca	1,184	0.01	0.07	0.91	3.47
	Silky shark	Carcharhinus falciformis	1,027	0.03	0.61	0.36	3.01
	Bigeye tuna	Thunnus obesus	1,027	0.53	0.34	0.14	3.01
	Yellowfin tuna	Thunnus albacares	800	0.70	0.22	0.09	2.34
	Albacore tuna	Thunnus alalunga	678	0.97	0.03	0.00	1.98
	White marlin	Tetrapturus albidus	575	0.00	0.27	0.73	1.68
	Blue marlin	Makaira nigercans	539	0.00	0.26	0.74	1.59
	Oil fish	Ruvetus pretiosus	417	0.38	0.29	0.33	1.23
	Longnose spearfish	Tetrapterus pfluergri	383	0.00	0.50	0.50	1.13
	Atlantic sailfish	Istophorus platypterus	244	0.00	0.57	0.43	0.72
	Ocean whitetip shark	Carcharhinus longlimanus	227	0.00	0.54	0.46	0.66
	Shark	Carcharinidea	191	0.00	0.00	1.00	0.56
	Bigeye thresher shark	Alopias superciliosus	174	0.20	0.40	0.40	0.51
	Wahoo	Acanthocybium solandri	156	0.78	0.11	0.11	0.46
	Skates/rayes	Chondrichthyes	156	0.00	0.11	0.89	0.46
	Barracuda	Sphyraenidae	122	0.00	0.29	0.71	0.36
	Spearfish	Tetrapterus spp	87	0.20	0.80	0.00	0.26
	Tiger shark	Galeocerdo cuvieri	70	0.25	0.00	0.75	0.20
	Snake mackerel	Trichiuridae	52	0.00	1.00	0.00	0.15
	Shortfin mako	Isurus oxyrinchus	52	0.33	0.00	0.67	0.15
	Tuna		52	0.00	0.33	0.67	0.15
	Bigeye cigarfish	Cupiceps spp	34	1.00	0.00	0.00	0.10
	Puffer	Tetraodontidea	34	0.00	0.50	0.50	0.10
	Dusky shark	Carcharhinus obscurus	34	0.00	0.00	1.00	0.10
	Scallop hammerhead	Sphyrna lewini	34	0.00	0.00	1.00	0.10
	Skipjack tuna	Katsuwonus pelamis	34	0.00	1.00	0.00	0.10
	Blackfin tuna	Thunnus atlanticus	34	0.00	1.00	0.00	0.10
	Squid	Myopsidae	17	0.00	0.00	1.00	0.05
	Other fish		17	0.00	0.00	1.00	0.05
	Longfin mako	Isurus paucus	17	0.00	1.00	0.00	0.05
	Bonito	Sarda sarda	17	0.00	0.00	1.00	0.05

* 1993 catch estimated from observer catch rates and reported effort

Source: Jean Cramer, "Large pelagic logbook newsletter - 1994," *NOAA Technical Memorandum*, NMFS-SEFSC-378 (NMFS, Southeast Fisheries Science Center: Miami, November, 1995), p. 29.

Appendix G1b1.--United States. Estimated fish catch in Caribbean longline fishery, 1993

Species		Individuals*	Kept	Discarded		Catch share
Common Name	Scientific Name			Dead	Alive	
		Number		Percent		
Swordfish	Xiphias gladius	16,887	0.86	0.09	0.05	49.50
Dorado (dolphin fish)	Coryphaenidae	3,865	0.83	0.01	0.16	11.36
Sharks						
Blue shark	Prionace glauca	1,184	0.01	0.07	0.91	3.47
Silky shark	Carcharhinus falciformis	1,027	0.03	0.61	0.36	3.01
Ocean whitetip shark	Carcharhinus longlimanus	227	0.00	0.54	0.46	0.66
Shark	Carcharinidea	191	0.00	0.00	1.00	0.56
Bigeye thresher shark	Alopias superciliosus	174	0.20	0.40	0.40	0.51
Tiger shark	Galeocerdo cuvieri	70	0.25	0.00	0.75	0.20
Shortfin mako	Isurus oxyrinchus	52	0.33	0.00	0.67	0.15
Dusky shark	Carcharhinus obscurus	34	0.00	0.00	1.00	0.10
Scallop hammerhead	Sphyrna lewini	34	0.00	0.00	1.00	0.10
Longfin mako	Isurus paucus	17	0.00	1.00	0.00	0.05
Subtotal						8.86
Lancetfish	Alephisauridae	2,716	0.88	0.88	0.12	7.96
Snake mackerels						
Escolar	Lepidocybium Flavobrunneum	2,072	0.50	0.33	0.17	6.07
Oil fish	Ruvetus pretiosus	417	0.38	0.29	0.33	1.23
Snake mackerel	Trichiuridae	52	0.00	1.00	0.00	0.15
Subtotal						7.45
Tunas						
Bigeye tuna	Thunnus obesus	1,027	0.53	0.34	0.14	3.01
Yellowfin tuna	Thunnus albacares	800	0.70	0.22	0.09	2.34
Albacore tuna	Thunnus alalunga	678	0.97	0.03	0.00	1.98
Skipjack tuna	Katsuwonus pelamis	34	0.00	1.00	0.00	0.10
Blackfin tuna	Thunnus atlanticus	34	0.00	1.00	0.00	0.10
Other		52	0.00	0.33	0.67	0.15
Subtotal						7.68
Billfish						
White marlin	Tetrapturus albidus	575	0.00	0.27	0.73	1.68
Blue marlin	Makaira nigercans	539	0.00	0.26	0.74	1.59
Longnose spearfish	Tetrapterus pfluergri	383	0.00	0.50	0.50	1.13
Atlantic sailfish	Istophorus platypterus	244	0.00	0.57	0.43	0.72
Spearfish	Tetrapterus spp	87	0.20	0.80	0.00	0.26
Subtotal						5.38
Wahoo	Acanthocybium solandri	156	0.78	0.11	0.11	0.46
Skates/rayes	Chondrichthyes	156	0.00	0.11	0.89	0.46
Other fish						
Barracuda	Sphyraenidae	122	0.00	0.29	0.71	0.36
Bigeye cigarfish	Cupiceps spp	34	1.00	0.00	0.00	0.10
Puffer	Tetraodontidea	34	0.00	0.50	0.50	0.10
Other fish		17	0.00	0.00	1.00	0.05
Bonito	Sarda sarda	17	0.00	0.00	1.00	0.05
Subtotal						0.66
Mollusks						
Squid	Myopsidae	17	0.00	0.00	1.00	0.05

* 1993 catch estimated from observer catch rates and reported effort

Source: Jean Cramer, "Large pelagic logbook newsletter - 1994," *NOAA Technical Memorandum*, NMFS-SEFSC-378 (NMFS, Southeast Fisheries Science Center: Miami, November, 1995), p. 29.

Appendix G1b2a.--United States. Pelagic longline species distribution, Caribbean landings, 1998-99

Species	1998		1999	
	Quantity	Proportion	Quantity	Proportion
	Kilograms	Percent	Kilograms	Percent
Albacore	2,598	1.2	2,454	2.1
Bigeye	8,689	4.3	3,960	3.4
Bluefin	122	0.1	591	0.5
Bluefish	-	-	-	-
Blackfin	-	-	73	0.1
Bonito	-	-	-	-
Blue shark	-	-	26	Negl
Black tip	-	-	-	-
Dorado	4,991	2.5	4,349	3.7
Dusky	-	-	-	-
Hammerheads	-	-	-	-
Kingfish	14	Negl	9	Negl
Mako-longfin	96	Negl	-	-
Mako-shortfin	1,330	0.7	723	0.6
Oilfish	3,801	1.9	2,890	2.5
Sandbar shark	-	-	-	-
Shark fins	7	Negl	9	Negl
Shark-unclassified	-	-	-	-
Skipjack	-	-	-	-
Silky shark	39	Negl	-	-
Swordfish	171,228	84.3	99,547	84.5
Thresher shark	188	0.1	529	0.4
Tilefish	-	-	-	-
Wahoo	676	0.3	87	0.1
Whitetip shark	687	0.3	465	0.4
Yellowfin	8,578	4.2	2,140	1.8
Total*	203,044	100.0	117,858	100.0

* Totals may not agree due to rounding.
Source: Angelo Bertolino, Southeast Fisheries Science Center, computer run, May 10, 2000

Appendix G1b2b.--United States. Pelagic longline species distribution, Caribbean landings, 1998-99

Species	1998		1999	
	Quantity	Proportion	Quantity	Proportion
	Kilograms	Percent	Kilograms	Percent
Bluefish	-	-	-	-
Bonito	-	-	-	-
Dorado	4,991	2.5	4,349	3.7
Kingfish	14	Negl	9	Negl
Oilfish	3,801	1.9	2,890	2.5
Sharks				
Blue shark	-	-	26	Negl
Black tip	-	-	-	-
Dusky	-	-	-	-
Hammerheads	-	-	-	-
Mako-longfin	96	Negl	-	-
Mako-shortfin	1,330	0.7	723	0.6
Silky	39	Negl	-	-
Sandbar shark	-	-	-	-
Thresher shark	188	0.1	529	0.4
Whitetip shark	687	0.3	465	0.4
Shark fins	7	Negl	9	Negl
Shark-unclassified	-	-	-	-
Shark, total*	2,347	1.2	1,752	1.5
Swordfish	171,228	84.3	99,547	84.5
Tilefish	-	-	-	-
Tunas				
Albacore	2,598	1.2	2,454	2.1
Bigeye	8,689	4.3	3,960	3.4
Bluefin	122	0.1	591	0.5
Blackfin	-	-	73	0.1
Yellowfin	8,578	4.2	2,140	1.8
Tuna, total*	19,987	9.8	9,218	7.8
Wahoo	676	0.3	87	0.1
Total*	203,044	100.0	117,858	100.0

* Totals may not agree due to rounding.
Source: Angelo Bertolino, Southeast Fisheries Science Center, computer run, May 10, 2000

Appendix G2a.--Puerto Rico. Turtle catch, 1965-1998

Year	Catch	
	FAO	NMFS#
	Metric tons	
1965	100*	NA
1966	100*	NA
1967	100*	NA
1968	100*	NA
1969	NA**	NA
1970	NA**	NA
1971	100*	12
1972	NA**	9
1973	NA**	8
1974	6	6
1975	11	9
1976	13	10
1977	-	NA***
1978-98	-	NA***

NA - Not available
Note: NMFS official Wayne Witzell reports that he believes that the Puerto Rican turtle catch was quite small prior to 1971. He is skeptical that it approached 100 tons as reported by FAO. He reports that there was no large commercial turtle fishery on the island. Fisheries statistics are not an exact science. There state (in Puerto Rico's case Commonwealth) and NMFS landings data can be different, although NMFS primarily relies n state reporting in compiling national data. In some instances the FAO *Yearbook* is completely different, especially for species of lesser importance with small landings. As a result he used the available NMFS data in his report. FAO may have obtained their turtle data directly from Puerto Rican authorities. Wayne Witzell, NMFS, personal communications, April 24, 2001.
* These estimates could mean catches of 50-149 tons.
** Less than 50 tons
*** Believed to be negligible
# Based on NMFS data which was first reported in *Fisheries Statistics of the United States* in 1971. The publication of *Fisheries Statistics of the United States* was discontinued after 1977. NMFS used published Puerto Rican sources for the data.
Source: FAO, *Yearbook of Fishery Statistics*, various years (FAO data) and W.N. Witzell, "The origin, evolution, and demise of the U.S. sea turtle fisheries," *Marine Fisheries Review*, vol. 56, no. 4, 1994, p. 21 (Witzell data).

Appendix G2b.--United States. Wider-Caribbean turtle interactions in Atlantic longline operations, with and without lightsticks, 1992-95

Area	Leatherbacks		Loggerheads	
	WithLS	WOLS	WithLS	WOLS
	CPUE: Turtles/1,000 hooks			
1 - Caribbean	0.064	0.030	0.052	0.020
2 - Gulf of Mexico	0.015	0.011	0.014	0.004
3 - Florida east coast*	0.017	-	0.009	-
8 - North equatorial**	0.349	0.778	0.077	-

* West of the Bahamas
** The limited effort in area 8 makes the data less reliable.
CPUE - Catch-per-unit-effort
WithLS - With light sticks
WOLS - Without light sticks
Source: Wayne N. Witzell, "Distribution and relative abundance of sea turtles caught incidentally by the U.S. pelagic longline fleet in the western North Atlantic Ocean, 1992-1995," *Fishery Bulletin* Vol. 97, No. 1, 1999, pp. 207.

Appendix G2c1.--United States. Loggerhead and leatherback turtles taken by longliners in or near Puerto Rico and U.S. Virgin Island waters, 1998-99

Coordinates	1998		1999	
	Loggerheads	Leatherback	Loggerheads	Leatherbacks
	Interactions			
19°N 65°W	-	-	-	1
Total	-	-	-	1

Note: Note this data does not include turtle incidents reported by the U.S. pelagic longline fleet east of the Caribbean in the Atlantic (appendix G2c2). Details on turtle interactions including the more heavily fished Windward Passage are available in the Cuban chapter of this report (Cuba, appendix F2b).
Source: NMFS data.

Appendix G2c2.--United States. Loggerhead and leatherback turtles taken by longliners east of the Caribbean in the Atlantic, 1998-99

Coordinates	1998		1999	
	Loggerheads	Leatherback	Loggerheads	Leatherbacks
	Interactions			
00°N 32°W	-	-	-	1
02°N 37°W	-	-	-	1
02°N 39°W	-	-	-	1
04°N 34°W	-	-	-	1
10°N 56°W	1	-	-	-
14°N 45°W	-	-	-	1
16°N 28°W	-	-	-	1
17°N 27°W	-	-	-	1
17°N 28°W	-	-	-	2
17°N 35°W	-	-	-	1
17°N 36°W	-	-	-	1
18°N 53°W	-	-	1	-
22°N 57°W	1	-	-	1
26°N 59°W	-	-	-	1
Total	2	-	1	13

Note: Details on turtle interactions including the more heavily fished Windward Passage are available in the Cuban chapter of this report (Cuba, appendix F2b)
Source: NMFS data.

Appendix G2d.--United States. Estimated catch of marine mammals, marine turtles, and birds in longline fishery, 1993

Area	Species		Individuals*	Kept	Discarded		Catch share
	Common Name	Scientific Name			Dead	Alive	
			Number	Percent			
Caribbean							
	Loggerhead turtle	Caretta caretta	70	0.00	0.00	1.00	0.20
	Leatherback turtle	Dermochelys coriacea	17	0.00	0.00	1.00	0.05
Grand Banks							
	Leatherback turtle	Dermochelys coriacea	306	0.00	0.00	1.00	0.34
	Loggerhead turtle	Caretta caretta	131	0.00	0.00	1.00	0.15
	Bottlenose dolphin	Tursiops truncatus	15	0.00	0.00	1.00	0.02
	Green turtle	Chelonia mydas	15	0.00	0.00	1.00	0.02
Gulf of Mexico							
	Leatherback turtle	Dermochelys coriacea	158	0.00	0.00	1.00	0.19
	Green turtle	Chelonia mydas	13	0.00	0.00	1.00	0.02
	Loggerhead turtle	Caretta caretta	13	0.00	0.00	1.00	0.02
	Grampus	Grampus griseus	13	0.00	1.00	0.00	0.02
	Turtle spp		13	0.00	0.00	1.00	0.02
NE Coastal							
	Leatherback turtle	Dermochelys coriacea	328	0.00	0.00	1.00	0.37
	Pilot whale	Globicephala sp	164	0.00	0.00	1.00	0.19
	Loggerhead turtle	Caretta caretta	59	0.00	0.00	1.00	0.07
	Grampus	Grampus griseus	23	0.00	0.00	1.00	0.03
	Gull	Larus sp	12	0.00	0.00	1.00	0.01
	Turtle spp		12	0.00	-	-	0.01
Southeastern							
	Loggerhead turtle	Caretta caretta	86	0.00	0.25	0.75	0.12
	Leatherback turtle	Dermochelys coriaces	86	0.00	0.00	1.00	0.12
	Pilot whale	Globicephala sp	21	0.00	0.00	1.00	0.03

* 1993 catch estimated from observer catch rates and reported effort

Source: Jean Cramer, "Large pelagic logbook newsletter - 1994," *NOAA Technical Memorandum*, NMFS-SEFSC-378 (NMFS, Southeast Fisheries Science Center: Miami, November, 1995), p. 32.

Appendix G2e1.--United States. Longline turtle, mammal, and seabird bycatch reported by U.S. observers in the Caribbean and adjacent areas, 1992-2000

Year	Area#	Turtles*		Marine mammals*		Seabirds		Total animals	Sets		Interaction rates
		Alive	Dead	Alive	Dead	Alive	Dead		Hooks	Hauls	
		Number							1,000 hooks	Number	Turtles/1,000 hooks
1992	Caribbean	2	1	-	-	-	-	3	4.4	11	0.45
	Florida east coast	-	-	-	-	-	-	-	9.4	39	-
1993	Caribbean	4	-	-	-	-	-	4	17.6	40	0.23
	Florida east coast	3	1	1**	-	-	-	5	31.0	85	0.10
	North central Atlantic	1	-	-	-	-	-	1	33.1	52	0.03
1994	Caribbean	2	-	-	-	-	-	2	14.9	35	0.13
	Florida east coast	2	-	-	-	-	-	2	22.1	84	0.09
	North central Atlantic	1	-	-	-	-	-	1	12.0	19	0.08
1995	Caribbean	-	-	-	-	-	-	-	21.4	48	-
	Florida east coast	6	-	1**	-	-	-	7	12.3	37	0.49
	North central Atlantic	9	-	-	-	-	-	9	60.3	83	0.15
1996	Caribbean	1	-	-	-	-	-	1	2.2	6	0.45
	Florida east coast	-	-	-	-	-	-	-	8.7	28	-
	North central Atlantic	3	-	-	-	-	-	3	30.7	41	0.10
	Equatorial Atlantic##	1	-	-	-	-	-	1	18.2	27	0.05
1997	Caribbean	1	-	-	-	-	-	1	3.7	9	0.27
	Florida east coast	1	-	-	-	-	-	1	17.2	49	0.06
	North central Atlantic	2	-	-	-	-	-	2	13.2	19	0.15
	Equatorial Atlantic##	1	-	-	-	-	-	1	2.9	4	0.34
	Far Equatorial Atlantic+	2	-	-	-	-	-	2	15.9	21	0.13
1998											
	Caribbean	2	-	1	-	-	-	3	6.1	10	0.32
	Florida east coast	5	-	-	-	-	-	5	10.9	57	0.46
	North central Atlantic	-	-	-	-	-	-	-	6.5	8	-
	Far Equatorial Atlantic	-	-	-	-	-	-	-	2.9	4	-
1999											
	Caribbean	7	-	-	-	-	-	7	12.2	17	0.58
	Florida east coast	4	-	-	-	-	-	4	21.9	61	0.18
	North central Atlantic	-	-	-	-	-	-	-	1.5	2	-
	Equatorial Atlantic##	-	-	-	-	-	-	-	1.7	2	-
	Far Equatorial Atlantic+	-	-	-	-	-	-	-	7.8	10	-
2000											
	Florida east coast	8	-	2	1	-	-	11	24.1	64	0.33
	North central Atlantic	5	-	-	-	-	-	5	10.5	15	0.48

See map with appendix D3c to locate these areas.
Referred to as "Tuna north" in the source.
+ Referred to as "Tuna south" in the source.
* Species indicated in appendix G2d.
** Pilot whale released alive.
Source: Dennis Lee, Observer Program Director, NMFS Southeast Fisheries Science Center, computer run of observer data, March 3, 1998.

Appendix G2e2.--United States. Longline turtle bycatch reported by U.S. observers in the Caribbean and adjacent areas, 1992-2000

Areas#	Year									Average**
	1992	1993	1994	1995	1996	1997	1998	1999	2000	
				Turtles/1,000 hooks*						
Caribbean	0.45	0.23	0.13	-	0.45	0.27	0.32	0.58		0.35
Florida east coast	-	0.10	0.09	0.49	-	0.06	0.46	0.18	0.33	0.19
North central Atlantic		0.03	0.08	0.15	0.49	0.15	-	-	0.48	0.18
Equatorial Atlantic##					0.15	0.34		-		0.16
Far Equatorial Atlantic+						0.13	-	-		0.04

Note: In some years and areas the data involved relatively limited data and is thus less statistically valid than during the years in which there was extensive effort.
See map with appendix D3c to locate these areas.
Referred to as "Tuna north" in the source.
+ Referred to as "Tuna south" in the source.
* Species indicated in appendix G2d.
** Averages based on a straight annual average. A computation based on fishing effort would give different results. Average based only on years when fishing occurred.
Source: Dennis Lee, Observer Program Director, NMFS Southeast Fisheries Science Center, computer run of observer data, March 3, 1998.

Appendix G3.--Puerto Rico. Seabird nesting, 1984

Area	Information	Species*	Known** threats	Importance***
Mona	Reasonable	3?, 6-7?, 9-10, 12?, 18-19, 22	Ha, Pr	Important
Monito	Good	6-10, 12?, 18-19, 22	Pr	Very important
Desecheo	Reasonable	10?, 12?, 18, 22?	Pr, Ha	Relatively unimportant
Puerto Rico	Good	5-6, 11, 13, 16, 18?, 20	Pr, Ex, Ha, Po	Important
Cordillera	Reasonable	10, 12, 16, 18-19, 22	Ha, Ex	Important
Vieques, ca	Reasonable	5, 6, 11, 16?, 18, 20	Ha, Ex	Important
Cúlebra, ca	Good	5-6, 8-9, 10, 12-14, 16, 18-19, 22	Ex, Ha	Very important

ca - including associated cays.
* Species: 3 - Puffinus I. lherminieri; 5 - Phaethon aethereus; 6 - P. lepturus; 7 - Fregata magnificens; 8 - Sula dactylatra; 9 - S. sula; 10 - S. leucogaster; 11 - Pelecanus occidentalis; 12 - Larus atricilla; 13 - Sterna maxima, 14 - S. sandvicensis acuflavida; 16 - S. dougallii; 18 -S. anaethetus; 19 - S. fuscata; 20 - S. (albifrons) antillarum; 22 - A. stolidus
** Threats: Ex - exploitation of eggs, young or adults; Pr - predators, generally introduced mammals; Ha - habitat destruction or disturbances; Po - pollution; Fi - fisheries
*** A rough subjective rating of relative importance of area for breeding seabirds.
Source: Ruud van Halewyn and Robert L. Norton, "The status and conservation of seabirds in the Caribbean," in J.P. Croxall, P.G.H. Evans, and R.W. Schreiber (eds.), "Status and conservation of the world's seabirds," *ICBP Technical Publication*, No. 2 (ICBP: Cambridge, 1984), p. 175.

Appendix H1.--Puerto Rico. Species glossary

English	Spanish	Scientific
Fish		
Barracuda	Picúa	Sphyraena barracuda
Billfish	Aguja	
Blue marlin	Marlín azul/aguja	Makaira nigricans
Sailfish	Vela/abanico	Istiophorus platypterus
Dolphinfish*	Dorado	Coryphaena hippurus
Mackerel	Sierra/macarela	
Cero	Alasana/pelicán	Scomberomorus regalis
King	Sierra	S. cavalla
Swordfish	Emperador/pez espada	Xiphias gladius
Tuna	Atún	
Blackfin	Albacora/bonito	Thunnus atlanticus
Little	Vaca	Euthynnus alletteratus
Skipjack	Albacora/bonito	E. pelamis
Yellowfin	Aleta amarilla	T. albacares
Wahoo	Peto	Acanthocybium lepturus
Turtles		
Green	Peje blanco	Chelonia mydas
Hawksbill	Carey	Eretmochelys imbricata
Leatherback	Tinglado	Dermochelys coriacea
Loggerhead	Cabezón	Caretta caretta

* Mahi is also commonly used.
Source: Various

Appendix H2a.--Puerto Rico. Fishery glossary

English	Spanish
Beach seine	Chinchorro (mesh sizes range from 0.5 in to 12.0 in, the larger mesh being used along the western coast)
Boats	Petreles--Larger artisanal boat
	Yolas--Small open traditional artisanal boat, averaging about 5.0-5.5 meters
Closure	Veda--Management measure closing a fishery
Fishing centers	Centros pesqueros--fishing centers or villages
Gillnet	Filete/trasmallo
Hand line*	Cala/linea
Hook and line	Cordel y anzuelo
Kebobs	Pinchos--Shark meat served as shish-kebabs
Lease	Usufructo (government lease with low fees)
Longline	Palangre
Markets	Plaza de mercado--central market
Spears	Fisgas
Trammel net	Mayorquín (mesh sizes range from 0.5 to 12.0 in, with the greatest diversity (smallest and largest mesh) being used along the western coast)
Traps	Nasas
Troll line*	Silga

* The way Puerto Rican fishermen operate, some times what some observers would describe as a handline is noted as a troll line. This is especially true for the artisanal fishermen operating off the northwest coast. Some observers describe their gear as a handline and some as a troll line.
Source: Various

Appendix H2b.--Puerto Rico. Fishery glossary

Spanish	English
Cala	Hand line
Centros pesqueros	Fishing centers or villages
Chinchorro	Beach seine: mesh sizes range from 0.5 in to 12.0 in, the larger mesh being used along the western coast
Cordel y anzuelo	Hook and line
Filete	Gillnet
Fisgas	Spears
Linea	Line
Mayorquín	Trammel net (mesh sizes range from 0.5 to 12.0 in, with the greatest diversity (smallest and largest mesh) being used along the western coast)
Nasas	Traps
Palangre	Longline
Petreles	Larger artisanal boat
Pinchos	Fish (often shark) served as shish-kebabs
Plaza de mercado	Central market
Silga	Troll line*
Trasmallo	Gillnet
Usufructo	Government lease with low fees)
Veda	Management measure closing a fishery
Yolas	Small open traditional artisanal boat, averaging about 5.0-5.5 meters

* The way Puerto Rican fishermen operate, some times what some observers would describe as a handline is noted as a troll line. This is especially true for the artisanal fishermen operating off the northwest coast. Some observers describe their gear as a handline and some as a troll line.
Source: Various

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